

CHAPTER FOUR

WORLD WAR II: THE AXIS ADVANCE, 1939-1942

World War II did more than force armies to integrate all the available arms at every level into a mobile, flexible team. It also forced those armies to adjust to a variety of threats and terrain. Despite the vast scope of the struggle, some major trends are evident. First, the mechanized combined arms force came of age in this war. In 1939, most armies still thought of an armored division as a mass of tanks with relatively limited support from the other arms. By 1943, the same armies had evolved armored divisions that were a balance of different arms and services, each of which had to be as mobile and almost as protected as the tanks they accompanied. The Soviet, German, and American armies cannibalized infantry-support tank units to form more armored divisions. Second, this concentration of mechanized forces in a small number of mobile divisions left the ordinary infantry unit deficient in both antitank weapons for the defense and armor to accompany the deliberate attack. The German, Soviet, and American armies therefore developed a number of tank surrogates such as tank destroyers and assault guns to perform these functions in cooperation with the infantry. Third, one of the driving forces in both of the previous trends was the gradual development of the means to counter and control the blitzkrieg. During the period 1939 to 1941, conventional infantry units were unprepared psychologically and technologically to defeat a rapidly moving armored foe who broke into their rear areas to disrupt communications and organization. By 1943, those same infantry units had lost their paralyzing fear of armored penetration and had acquired a much greater antitank capability. Successful armored penetrations were still possible, as the Soviets demonstrated, but they were increasingly difficult. Finally, World War II represented the end of pure ground operations. Mechanized attack required air superiority and close air support, airborne landings required close coordination between air transport and ground forces, and amphibious landings developed as the most sophisticated and complicated form of combined arms and joint operations. Such joint service interaction was not achieved without operational errors and doctrinal arguments, but by the end of the war ground commanders had reached a temporary working compromise with the other services on most questions.

The best way to examine these developments is to consider the actions and reactions of the opposing armies during the course of the war. This chapter will begin with the reasons for the German success of 1939 and 1940, followed by British reactions and adjustments to that success. Turning to the next cycle of developments, the German victories in Russia during 1941-42 must be compared with Soviet efforts to adjust organization and tactics both before and after the German invasion. After reviewing American developments in organization, the next chapter

will consider the many technological advances of the war, then survey the development of Allied antitank, mechanized, and close air support operations in the second half of the war. Specialized cases such as airborne, amphibious, and unconventional operations are discussed separately at the end of Chapter Five.

Poland, 1939

During the first seventeen days of September 1939, Germany overwhelmed Poland and occupied more than half of its territory. The western Allies, who were still mobilizing and training their reserve components, were unable to make more than a symbolic attack along the French-German border during this period. Yet the speed of the German conquest obscured a number of problems that the Germans encountered, problems that they attempted to solve during the winter of 1939-40. As a result, the Germans widened the gap of experience and experimentation that separated them from their future opponents, Great Britain and France.¹

To begin with, the German higher commanders had not accepted Guderian's theories and did not employ their mobile divisions in mass for deep exploitation. The panzer and light divisions were parceled out among the various armies. The only exception was the German Tenth Army, which had two panzer, two motorized, and three light divisions in addition to its six conventional infantry divisions. In general, the mechanized and motorized forces were employed as the cutting edges of a more conventional advance on a broad front, with relatively shallow penetrations of the Polish defenses. Not until after organized Polish resistance collapsed did armored forces exploit into the rear for any distance.²

Although German tanks and motorized infantry had developed techniques for close interaction, the same was not true between these elements and their fire support. Within hours of the first attack, General Guderian was bracketed by his own artillery, which violated orders by firing blindly into the morning fog. The Luftwaffe concentrated on achieving air superiority and interdicting Polish lines of communication, rather than on supporting the ground troops directly. The complexity of close air support operations, the problems of coordinating and communicating between air and ground units, and the lack of training in such methods made it very difficult for the Luftwaffe and army to work together.

Many German tactical commanders were too cautious, allowing themselves to be halted by even minor Polish resistance. This was a natural response for an army that had not seen combat for years, but it was not appropriate to the situation. The Poles were probably doomed at the outset, because they had dispersed

their forces along the entire Polish-German border in an effort to prevent any limited German grab for territory. Under the circumstances, German forces needed to punch through the thin Polish frontier defenses rapidly, rather than stopping to deploy whenever they made contact with Polish troops.

The German system of division and higher level commanders going forward to make on-the-spot decisions greatly increased the tempo of operations. However, the same system had several drawbacks that were evident even in this first campaign. The presence of a higher commander on the scene tended to inhibit the initiative of the battalion or regimental commander. This inhibition may have been partially responsible for the caution displayed by German units in Poland. Moreover, the senior commanders were extremely vulnerable to enemy attack while moving about in a fluid battle. For example, Guderian, a corps commander, was pinned down for hours by a few bypassed Polish troops. This was a recurring problem for leaders in many armies during World War II, especially for the more daring German commanders in North Africa. Ultimately some, like Rommel, organized ad hoc security task forces to travel with them. Yet such a security force reduced the combat power of subordinate units and at the same time increased the tendency for a senior commander to become involved personally in the small unit actions he saw when he visited the front. If he lost radio contact with his headquarters, the senior commander became isolated and even less effective.

Although no German unit advanced more than 250 kilometers into Poland, significant problems of supply and maintenance developed. All major tank repairs required evacuation to Germany, and forward maintenance units were unprepared for the new demands of active campaigning. By the end of the Polish campaign, the German mechanized force was almost immobilized for maintenance reasons.

A related problem was the unsuitability of German equipment. As noted in the previous chapter, the Germans had intended the Mark I tank for training rather than combat, and the Mark II was scarcely better. The use of such vehicles in Poland reflected two problems: Germany had begun the war before her mechanized forces had developed completely, and those forces still did not have priority for industrial production. During the month of September 1939, for example, the Germans lost 218 tanks in battle, approximately 10 percent of their entire force, while manufacturing only fifty-seven new ones. Even at the time of the invasion of France eight months later, the second generation Mark III and IV medium tanks constituted less than one-fourth of German tanks in field units.³ The Polish campaign did accelerate the retirement of Mark Is by revealing their deficiencies and may have hastened the movement of Mark IIs into

reconnaissance, engineer, and command units. As a result, the relatively few Mark III and IV tanks bore the brunt of the effort in 1940.

By contrast, other German equipment had unexpected uses. The half-tracks originally intended as prime movers for artillery proved to be so mobile that infantry units in panzer divisions sought to acquire them as armored personnel carriers. The vast majority of panzer grenadiers, however, continued to travel in trucks and motorcycles throughout the war; there were never enough half-tracks available. The 88-mm antiaircraft gun proved to be extremely useful in a ground-support role, foreshadowing its later use as the premier antitank weapon of the German Army.

A basic result of the German invasion of Poland was to begin the slow evolution of the German panzer division structure towards greater balance among the arms. At the time of the Polish campaign, the six panzer divisions averaged between 276 and 302 tanks each, organized into a panzer brigade of four battalions. Those same divisions had only three battalions of infantry and two of artillery. This tank-heavy force proved too unwieldy for some commanders, and in any event Hitler was interested in creating more panzer divisions. At the same time, the German "light divisions," built around two motorized infantry regiments and one tank battalion, proved to be too light for sustained operations, lacking the combat power of either a panzer division or a conventional infantry division. Given the limited number of tanks in the German inventory, the solution was obvious--tanks moved from the existing panzer divisions to the light divisions, three of which became panzer divisions during the winter of 1939-40. In addition, during the Polish campaign an ad hoc panzer division had formed around one of the infantry-support tank brigades created in 1938; this formation became the 10th Panzer Division. Thus, by the time of the French campaign, even more of the available German tanks were concentrated into panzer divisions, some of which were reduced from a four-battalion tank brigade to a three-battalion tank regiment, with a total of 160-200 tanks. This put the tank element in balance with the rest of the division, which normally consisted of three infantry battalions and two or three towed artillery battalions, an armored reconnaissance battalion, engineer battalion, and signals.⁴ This trend towards a more balanced division would continue throughout the war.

Regardless of exact organization, all the panzer divisions were in the habit of task organizing for combat. The brigade, regimental, and battalion headquarters all practiced attaching and detaching elements of other arms in order to have a combination of tanks, infantry, artillery, engineers, and, on occasion, air defense. The balance between these arms varied with the mission, terrain, and enemy forces involved.

Beyond these organizational changes, German tactical concepts and structures seemed essentially sound. With the exception of a few technical problems with a particular machine gun design, the infantry divisions functioned well. The only other lesson of the Polish campaign was the predictable discovery that armored forces were at a disadvantage when fighting on urban terrain--fifty-seven tanks were lost in one day while attempting to seize Warsaw.⁵ This experience only reinforced the need for a higher proportion of infantry to tanks, in order to provide close-in security for the tanks on urban terrain, where the tanks were vulnerable to short-range antitank attacks from nearby buildings.

The German Advance, 1940

Between the fall of Poland in 1939 and the beginning of the Belgian-French campaign in May 1940, another German operation unsettled Allied morale and foreshadowed the future complexity of joint operations. On 9 April 1940, an improvised German force used motor movements, small-scale airborne drops, and seaborne landings to occupy Denmark and Norway by surprise. Only one of the six German divisions sent to Norway was a fully trained, established organization, yet all units performed remarkably well. Despite the shoestring nature of the German operation, this "warfare in three dimensions" (land, air, and sea) caused a shift of Allied resources and planning away from the battlefields of France.⁶ This shift meant further confusion and delays in the process of mobilizing and training the British and French troops.

The stunning operations in Denmark and Norway preceded another surprise when the main battle in France and Belgium was joined. On 10 May 1940, a small party of German glider troops landed on top of the elaborate concrete fortress of Eben Emael, the key to the Belgian defensive system. Using shaped-charge explosives* and the element of surprise, these Germans blinded and neutralized the huge fortress until ground troops arrived, thereby eliminating one of Belgium's main defenses.⁷ This surprise, coming on the heels of the Norwegian invasion, caused many Allied military and civilian leaders to become excessively

*The "shaped charge" was a concept fully developed only during the 1930s. It allowed the user to focus the blast of a particular amount of explosive in order to achieve a much greater effect than the same explosive would produce if detonated normally. The essence of this shaping was to mold the explosive with a cone-shaped hollow on one end, so that the blast effect that centered within that hollow would produce a shock wave in one direction, towards the wide end of the cone.

concerned about the rear area threat posed by airborne and unconventional warfare forces. Such concern was the first step in creating the psychological uncertainty that was so critical to the success of the blitzkrieg.

Conquering Belgium and France required more than propaganda and a few paratroopers to create psychological paralysis. Contrary to frequent stereotypes, the western armies were remarkably well armed by 1940, having greatly increased their production during the later 1930s. One calculation indicates that Britain and France had a combined total of 4,340 tanks on the continent during the 1940 campaign, as compared to only 3,863 for Germany. Despite weaknesses such as lack of radio communications and crowded turrets, most of the Allied tanks were actually better armed and armored than their German counterparts. Only the light British cruiser tanks were more vulnerable. For instance, one obsolete French FCM tank took forty-two hits from German 37-mm antitank guns without being knocked out of action. The Germans had to bring up 88-mm antiaircraft guns or medium artillery to deal with the more heavily armored French B-1 bis and British infantry support tanks. Indeed, the Germans were disturbed by the general ineffectiveness of their antitank weapons. By contrast, the outnumbered French 25-mm and 47-mm antitank guns had much higher muzzle velocities and therefore greater armor penetration capacity than the German and British guns.⁸

Yet the Germans defeated the Allies so rapidly that they seemed to validate the concept of blitzkrieg in Germany and abroad, even when the details of this concept were not well understood. The true reasons for this success have already appeared in this study.

First, in contrast to their own performance in Poland and to the French dispositions in 1940, the Germans concentrated their available mechanized forces into a few large masses at critical points. Seven out of ten panzer divisions, with five motorized divisions following close behind them to mop up and protect the flanks, advanced through the Ardennes forest on a seventy-kilometer front. By contrast, the French Army dispersed thirty-six tank battalions evenly along its borders in support of infantry armies, even in the Maginot Line area. In most cases these battalions had never trained with the infantry and artillery to conduct a deliberate attack or counterattack. Much of the remaining French and British armor was in the extreme north, moving into Belgium in a direction away from the main German advance on Sedan. Four French armored divisions were still forming, but these were scattered at wide distances behind the front and were broken up in some cases when committed to battle.⁹

In addition, the western Allies had organized themselves for a linear defense, spreading their forces thinly across a wide front. The French command structure in particular was geared to methodical, set-piece battles, but lacked the forces to create a true defense-in-depth on the World War I model. By rushing through the Ardennes forest, the main German attack shattered this linear defense at one of its weakest points. By the fifth day of the campaign (14 May 1940), the German mobile forces were conducting the type of deep exploitation envisioned by many theorists during the 1930s. Such penetrations were psychologically unnerving to the defenders, who were suddenly faced by major enemy forces in the rear, but who lacked a procedure to redeploy units rapidly to meet and contain that threat. The rapid German advance disorganized French command and control and prevented any restoration of a cohesive defense.

Because there was so little resistance, the German commanders did not always lead with tanks. Instead, the armored reconnaissance battalions, plus in some cases engineers to clear obstacles, led the advance by up to a day's march, with the slower elements strung out in column behind. Commanders used armored vehicles or light aircraft for control during the pursuit. Of course, this advance in column made the Germans rather vulnerable if the defenders were able to mount a counterattack, as Erwin Rommel discovered when the British struck the flank of his panzer division at Arras on 21 May. Only the improvised use of 88-mm antiaircraft guns and 105-mm howitzers in an antitank role halted the heavy infantry-support tanks of the British 1st Army Tank Brigade. The British did not realize that the 88-mm gun was responsible for their defeat until they met the weapon again in North Africa. Even this unsuccessful British counterattack at Arras put some of the fear of tanks into the German higher commanders, causing German armor leaders to seek larger antitank weapons and higher velocity tank guns after Arras.¹⁰

At the tactical level, both the British and the French were at a distinct disadvantage in force structure and practice. German armored divisions were clearly better organized than those of France. The French Division Cuirassée was too tank-heavy, with four tank and only one infantry and two artillery battalions. When ordinary infantry or artillery units were attached to this division to correct the problem, the attached units had not trained to cooperate with tanks. French logistical support was too dependent on roads and rails to follow the all-terrain maneuver elements of these divisions. Finally, the inexperienced French commander of an armored division had to control most of his subordinate units directly; the "demi-brigade" headquarters that controlled his tank battalions were not trained or intended to integrate the other arms. By

contrast, the German commanders had a number of subordinate headquarters, each of which had practiced the control of a combination of the various arms.

German training in combined arms was especially evident during the penetration of the Ardennes. The rapid German advance over a poor road network was made possible only by road repairs conducted by combat engineers. Anti-aircraft guns in the German columns decimated Allied air attacks. At the critical crossing of the Meuse River on 13 May, the German infantry and some engineers crossed the river under the covering fire of tanks, artillery, and tactical aircraft. Indeed, the Germans had relied on air support to limit the need for artillery units and ammunition resupply while moving through the Ardennes. Because close air support was still developing, however, the success at the Meuse River was a combination of good training and luck. In exercises before the campaign, Guderian had arranged for accurate air support from German dive-bombers, without which it would have been difficult to suppress the French defenses on the far side of the river. The day before the attack, the panzer group commander, General Ewald von Kleist, attempted to arrange high altitude saturation attacks by the less accurate medium bombers. This would have made crossing the Meuse during bombing attacks extremely dangerous for the Germans. Fortunately for them, the Luftwaffe did not honor von Kleist's air support request in time, while Guderian's prearranged dive-bombers did arrive.¹¹

The fall of France demonstrated not only the importance of combined arms mechanized formations and blitzkrieg penetrations, but also the German advantage over the British and French in combined arms training and procedures. Yet the images of paratroops, tanks, and screaming Stukas tended to obscure the combined arms nature of blitzkrieg from many contemporary observers.

The British Response, 1940-42

The sudden collapse of France in 1940 caused professional soldiers in many armies to reassess their organizations as well as their offensive and defensive doctrine. As the only major belligerent still at war with Hitler, Great Britain had the most urgent need to reorganize its forces and reassess its doctrine in the months after Dunkirk. Unfortunately for the British, the period 1940-42 seems in retrospect to have witnessed the development of two British armies--the army at home, which gradually rebuilt and developed new doctrine and organization, and the field army in the Middle East, which after initial success against Italy found itself repeatedly outmaneuvered by the small forces of the German Afrika Korps. The British troops in North Africa were never able to reorganize and retrain as did

the army at home. Yet these two armies were connected in doctrine if not in practice, and the British victories of 1942-45 owed a great deal to the quiet process of rebuilding forces at home.

Faced with the possibility of German invasion after France surrendered, the British felt that there was no time for major changes in organization, doctrine, or equipment. In a desperate effort to rearm the troops evacuated from Dunkirk, British industry continued to produce weapons whose designs were clearly obsolete. Cruiser tanks, armored cars, and two-pound antitank guns appeared by the hundred because there was no time to redesign and build better weapons.¹² Some British commanders became preoccupied with the material difficulties of obtaining trucks to motorize infantry elements within the newly formed armored divisions, thereby obscuring the more fundamental need for doctrine and techniques of infantry-armor cooperation. The British did develop some new weapons during this period, most notably a six-pound (57-mm) gun for use both as an antitank weapon and as the main gun on new tanks. Yet this gun did not appear in the field until 1942, and even then was too large to be mounted in the turrets of older model tanks.¹³

As the threat of invasion lessened, the British Army could emphasize training and reconsider its prewar doctrine in light of the experiences of 1940.¹⁴ The General Staff published a series of notes from various theaters, identifying such points as the need for combined arms organization below division level and the German use of antitank weapons rather than tanks to defeat enemy tanks. Under the direction of Gen. Alan Brooke, Commander-in-Chief Home Forces and later Chief of the Imperial General Staff, the units of the expanded active and reserve (Territorial Army) forces conducted training at all levels. Some of this training was simply an improvement on prewar principles, such as the development of fire-and-movement battle drills for small infantry units. Col. H. J. Parham experimented with a single radio net to mass artillery on the basis of an estimated map reference; the results were rather inaccurate, but in the absence of the American fire direction center, Parham's ideas allowed the Royal Artillery to provide at least some response to targets of opportunity.

The most unusual feature of the period 1940-42 was the conduct of large-unit command post exercises and field maneuvers, with detailed study before and critiques after each step. Lt. Gen. Bernard L. Montgomery had pioneered such exercises as a division commander in France during 1939-40, enabling his division to move more rapidly and flexibly than most other British units. After Dunkirk, Montgomery applied the same training techniques as commander of two different corps and finally of an army-level force. He also acted as chief umpire

for exercises involving other units in Britain. Similar if less elaborate training took place in the newly formed armored divisions under Lt. Gen. Giffard Martel, the Commander of the Royal Armoured Corps after December 1940.

Montgomery contended that few British officers had experience maneuvering any unit larger than a brigade, and certainly his exercises helped to produce commanders, staffs, and units that were capable of much more rapid changes in deployment and mission than those of World War I. More importantly, Montgomery and others developed a common conception of the interaction of different arms and of how to commit divisions and larger units to battle. For example, Montgomery argued that the decentralized nature of German mechanized pursuit and exploitation had caused many British commanders to lose sight of the necessity for centralized control in the deliberate attack and defense. Reconnaissance, artillery, tanks, infantry, engineers, and air power had to be "stage-managed" at the highest levels in order to concentrate combat power at any point where the enemy presented an organized defense or attack. Only in a fluid situation could commanders decentralize these arms and push them forward, so that subordinate leaders would have the different weapons readily available. Defense meant not a series of fixed lines on the terrain, but rather blocking positions in depth plus massive counterattacks of the kind Germany had used so well in World War I. All arms needed to employ night attacks to reduce the lethal effects of aimed enemy fire. Finally, Montgomery opposed the traditional British concept that tank units should maneuver like cavalry. Instead, he saw the armored division as a combined arms force that would seize key terrain in order to use the advantages of tactical defense when the enemy armor counterattacked. Infantry and antitank forces would follow the initial armored assault to mop up and hold terrain, releasing the armor to refit or attack again.¹⁵

In the Royal Armoured Corps, Martel developed these same concepts in a series of exercises, until in June 1942 the senior armor commanders in Britain agreed to an "RAC creed." This creed--a product of exercises and of a critical analysis of events in North Africa--began, "an armoured division is a formation of all arms. Each arm or branch of the service is a member of the team, and has its vital part to play." Like the Germans before them, British armor commanders concluded that antitank guns were the best means to defeat enemy tanks, although tank-tank combat might still occur. Motorized infantry and antitank weapons together would hold key terrain, around which the armored forces maneuvered.¹⁶

Changes in organization accompanied changes in doctrine. Immediately after Dunkirk, the pure tank brigades of the early armored divisions had given way to brigades composed of one motorized infantry and three tank battalions.* A 1940 British armored division therefore consisted of an armored car reconnaissance battalion, two armored brigades, and a support group, which included battalions of field, antitank, and light antiaircraft artillery, an additional infantry battalion, two engineer companies, and trains. Martel and his subordinates deliberately retained this organization until 1942 to avoid constant changes that would disrupt training.

By 1942, however, this structure was obviously too tank-heavy, and so the War Office removed one of the two armored brigades from the division (see Figure 9). The separate brigades that resulted from this removal could reinforce any division as needed for a particular mission. Moreover, the term "support group" had apparently caused the nonarmored elements of the division to be regarded as an afterthought to the tanks. A motorized infantry brigade plus a division artillery element therefore replaced the support group, with the intention that artillery, antitank, antiaircraft, engineer, and support elements would be centralized or attached to the armored or infantry brigade as needed. At the same time, the British created two different types of infantry division. The "division" per se, apparently intended for Asian operations, retained the traditional configuration of three infantry brigades of three battalions each. Conversely, the "infantry division" lost one brigade in favor of an infantry-support tank brigade. Martel and the new Commander-in-Chief Home Forces, Bernard Paget, strongly advocated this latter change in order to improve training and cooperation between infantry and supporting tanks.¹⁷ Unfortunately, the British returned to a division of three infantry brigades by 1944. As a result, the quality of tank-infantry cooperation in 1944-45 varied widely between different divisions.

War in the Desert, 1940-42

The battles of North Africa did not always reflect the state of the British Army at home. In late 1940, the small force in the Middle East was the only British field army still trained to

*The British frequently used the term "regiment" to designate an armored force equivalent to an American battalion. American terminology and symbology are used here for simplicity.

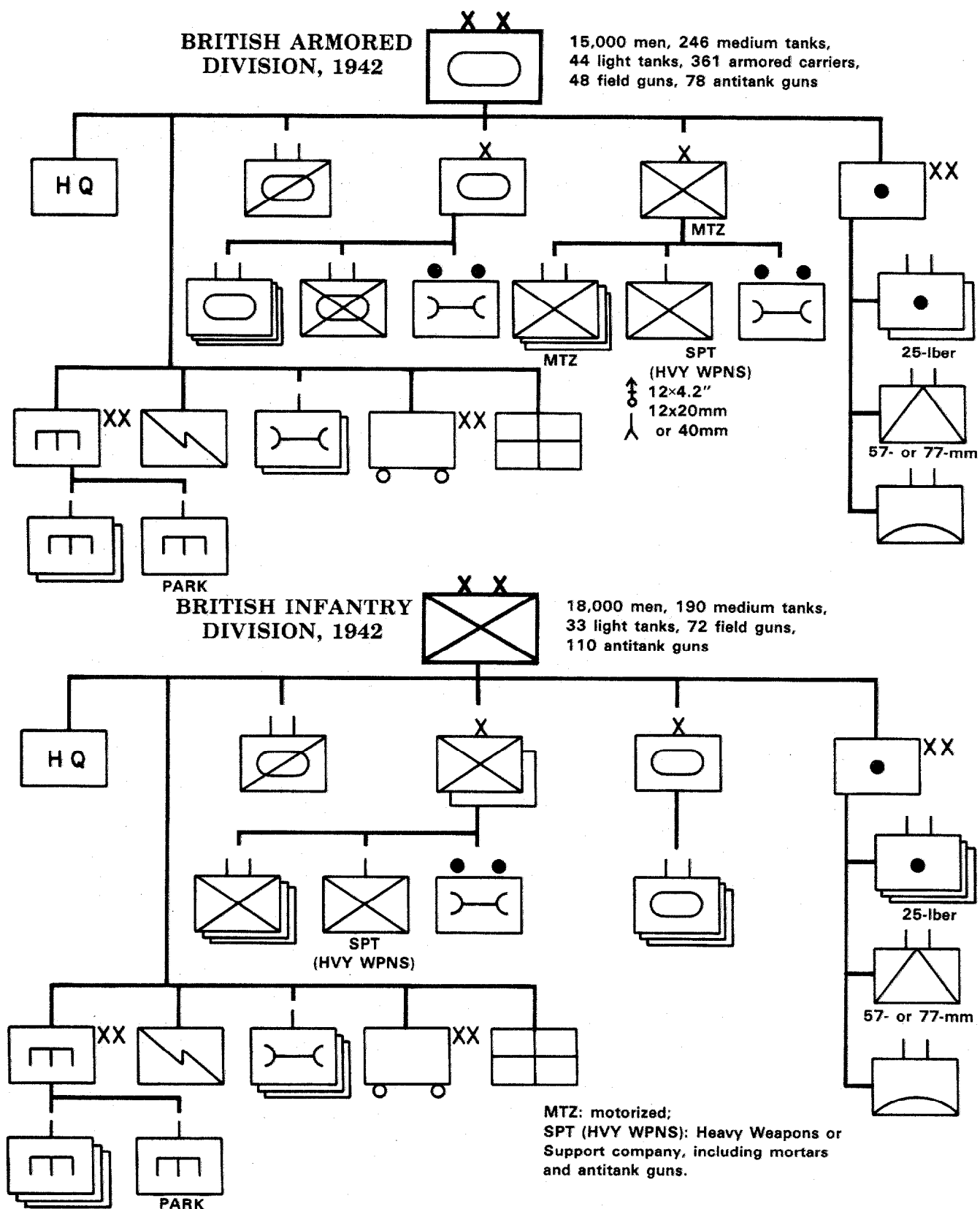
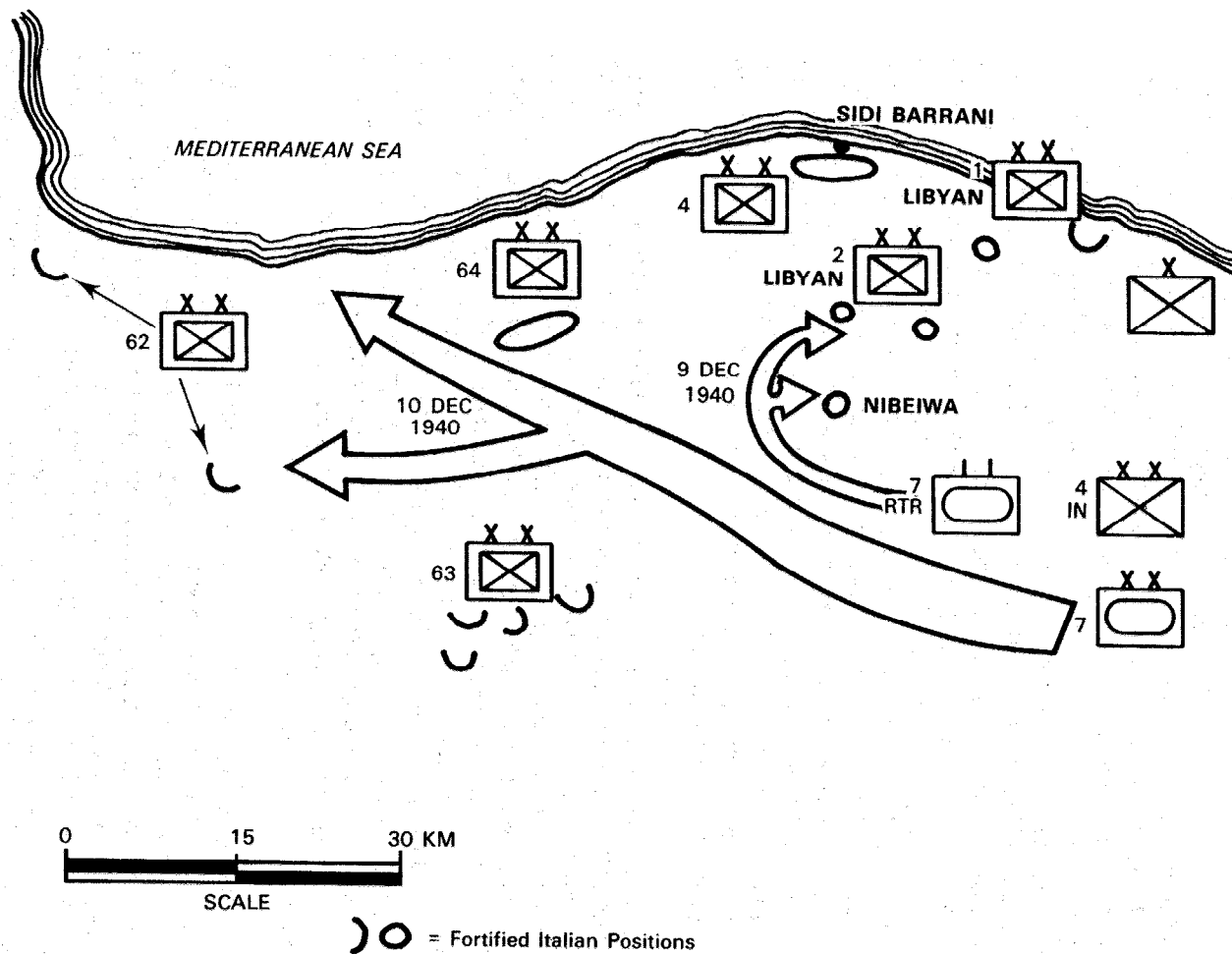


Figure 9. British Armored and Infantry Divisions, 1942.

high prewar standards, although its equipment was little better than that found at home. Once Italy joined the war on Germany's side in mid-1940, Prime Minister Winston Churchill took a calculated risk and sent a portion of his scarce resources to defend Egypt against the threat from Libya, which was an Italian colony at the time. The shipment included a single battalion (7th Royal Tank Regiment) of heavily armored Mark II infantry support tanks. This battalion, in combination with the two understrength but well-trained divisions already in Egypt, was the basis for a classic demonstration of prewar British tactical doctrine (see Map 5).

In September 1940, Marshal Rudolfo Graziani's Italian army of ten divisions had advanced eastward from Italian Libya into British Egypt. Graziani was cautious, however, and in any event his force was largely foot mobile with poor logistical support. He therefore halted and established a series of widely scattered camps in the general area of Sidi Barrani, about eighty kilometers east of the Libyan frontier. Lt. Gen. Richard O'Connor, commander of the British Western Desert Force, used the infantry support tanks in conjunction with the 4th Indian Infantry Division to reduce these camps in a surprise advance on 8-10 December 1940. The tactics involved exemplified the best of interwar British practice.¹⁸ Because the Italian camps were protected by minefields and obstacles, the British passed between these camps and attacked them from the far (western) side, aiming at the unmined entrance road to each camp. Artillery and mortar fire pinned the defenders down and distracted attention from the unexpected assault. Then two companies of the slow infantry tanks moved forward, with platoons of Bren gun carriers following behind and to the outside flanks, providing flank security and machine gun fire for the tanks. As soon as the British tanks broke into the enemy positions and came to close quarters, infantry moved up as closely as possible in trucks, dismounted, and accompanied the tanks in mopping-up operations.

After the tank-artillery-infantry team had reduced the enemy defensive system, the 7th British Armoured Division used its light, mobile armored vehicles to conduct a high-speed pursuit. The retreating Italians lacked effective tanks or antitank weapons and were tied to the single road that paralleled the Mediterranean Sea. The 7th Armoured Division therefore made a series of wide flanking movements south of the road, repeatedly turning north to the coast in order to intercept the Italian retreat. This Italian disaster led to the introduction of German forces in North Africa.



Map 5, Sidi Barrani, December 1940.

The roots of the British victory lay in advantages of superior training, mobility, and equipment. German intervention negated these assets. In early 1941 and again a year later, the British reduced their forces in Egypt in favor of needs elsewhere--first in Greece and, then, after Japan entered the war, in Southeast Asia. As a result, when the German Afrika Korps attacked in March 1941, it met only partly trained British troops equipped with worn out and inferior equipment. Thereafter, German victories and London's repeated demands for British counteroffensives meant that the British desert forces had little time to analyze their mistakes and to train to correct them. With few exceptions, the senior British commanders did not stay in office long enough to learn and apply the lessons of the desert war. The Germans had arrived in Africa with a system of combined arms battlegroups, flexible commanders, and variable tactics to mass combat power on the basis of battle drills. By contrast, the British units had rarely studied combined arms tactics. Newly arrived units from Britain might be better trained, but were often squandered piecemeal before they had become acclimated to the desert.

The Germans also had a considerable technological advantage in equipment.¹⁹ After their shocking encounter with British infantry-support tanks in France, the Germans had experimented with the 88-mm antiaircraft gun to test its effectiveness as an antitank weapon against captured British equipment. The German divisions sent to Africa had a number of organizational modifications, such as less field but more antitank artillery, including a small number of 88-mm guns. In addition, the German tanks in Africa were largely Mark III and IV medium tanks, with Mark II tanks in reconnaissance and command elements. These medium tanks were considerably better armed and armored than the British cruiser and light tanks.

During the course of 1941, a 50-mm medium-velocity main gun replaced the 37-mm on most Mark IIIs. Then in mid-1942, the Germans installed an even higher velocity 50-mm on some Mark IIIs, giving them the same penetration power as the 50-mm towed antitank gun that had already replaced the ineffective German 37-mm. This new 50-mm tank gun had improved sights and fired special "arrowhead" ammunition (an early form of Armor Piercing Discarding Sabot) capable of penetrating even thickly armored infantry support tanks at short ranges. By contrast, the Germans had designed the Mark IV to provide area fire support for other tanks, suppressing enemy antitank defenses while the Mark IIIs closed in the attack. As such, the Mark IV's original armament was a 75-mm low-velocity gun capable of damaging British tracks and roadwheels at 1000 meters, but not of penetrating thick armor. Again during 1942, the continuing German quest for

gunpower caused some Mark IVs to receive a higher velocity 75-mm gun. All of these weapons outclassed the British two-pound tank and antitank gun. As late as May 1942, the British forces had only 100 six-pound antitank guns and were just receiving their first American Grant tanks with 75-mm guns. Considering that the frontal armor on German tanks was face-hardened, while that on British tanks was not, the British had to close to almost suicidal ranges of 500 or fewer meters in order to penetrate the German vehicles. In many cases, the British had to hit a German tank twice--once to shatter the face hardening and a second time to penetrate the armor.

These equipment problems obscured the more basic British failure to coordinate and combine different weapons systems. Despite Martel's efforts, British tank battalions in Britain and North Africa found it difficult to resist the temptation to close with the enemy, even when they had not located the enemy's antitank guns. Because the basic German tactic for dealing with enemy armor was still the antitank gun line, this British tendency was disastrous. On 15 June 1941, for example, a few German tanks decoyed the 16th Royal Tank Regiment into a screen of 50-mm antitank guns; the British lost 17 tanks in a matter of minutes.²⁰ Such bitter lessons rapidly convinced the British to value gun power above all other elements and to regard infantry as a liability in the desert. The armor's tendency to maneuver on its own often left the infantry exposed, and the resulting mistrust made any attempt at cooperation between these arms extremely difficult. In those cases where the British and Commonwealth infantry was able to entrench effectively, the commanders chose positions that were not mutually supporting, so that the Germans could concentrate all available firepower against one British unit at a time.

Early in the desert war, British commanders apparently grasped the German concept of combined arms task organization at the small-unit level, but did not always develop the tactics to complement that organization. As Montgomery was preaching in Great Britain, the tendency to form combined arms units of battalion and brigade size was not always appropriate or sufficient, and caused the divisions to fight as uncoordinated and dispersed collections of small units. The concentrated efforts of the German Afrika Korps often defeated these British task forces in detail.

The British tried to reverse this process. General Martel visited North Africa in early 1942, and the local armor commanders agreed to the newer concepts of a combined arms armored division. The local units, however, did not implement these changes in organization and tactics before the next German offensive, so the British again lost armored "brigade groups"

piecemeal despite their intentions to employ divisions as unified forces. After losing most of their tanks, the British resorted to small motorized columns built around the few remaining effective field and antitank artillery units, with just enough motorized infantry to provide local security for those units. "Excess" infantry went to the rear.²¹

This was the situation when Montgomery took command of Eighth British Army in August 1942. Lt. Gen. Brian Horrocks, who had participated in Martel's training exercises as an armored division commander, arrived soon thereafter to command one of the corps. In effect, Montgomery had to retrain the Eighth Army from scratch, focusing upon the problems of centralized command and control for set-piece battles.

The British gained time by halting the Germans at Alam Halfa (31 August-5 September 1942). Having predicted the key terrain that the Germans would have to seize, British and Commonwealth defenders dug in to deny the enemy that terrain. The Royal Air Force attacked German armor while it was immobilized in British minefields. The main British defenses included Grant tank fire at long range, towed antitank guns at closer range, and finally massed artillery protective fires at short range. These successive defenses exhausted the German attacks.²²

After Alam Halfa, Montgomery used an abbreviated form of his training program from Britain to prepare the Eighth Army for the deliberate attack known as the second battle of Alamein (October-November 1942). To ensure that the entire army attacked in a coordinated manner, Montgomery resorted to the elaborate planning and centralized direction characteristic of British attacks in World War I. Each corps directed its artillery, for example. Such procedures were more familiar to British staff officers than the fluid, improvisational tactics that they had attempted to copy from the Germans. Engineers, infantry, and artillery conducted a night penetration of the German-Italian defensive positions, seizing high ground on which to establish infantry-antitank defenses. Next, Montgomery planned to move armor forward under the protection of these antitank defenses, tempting the Germans to counterattack. In actual practice, the second battle of Alamein was an attrition contest in which Montgomery's plans changed frequently, largely because the armored units still had difficulty cooperating with the artillery and infantry. The ultimate British success clearly owed as much to Montgomery's methods of forcing combined arms cooperation upon his subordinates as to the British material superiority at the time. Historians have frequently criticized Montgomery for the cautious manner in which he conducted both deliberate attacks and more fluid exploitation and pursuits. Yet this caution enabled

him to minimize or avoid the errors of his predecessors, errors caused in large part by an inability to coordinate the different arms.²³

The German Advance in Russia, 1941

While Germany went from victory to victory in the period 1939-41, the Soviet Army stood nearly impotent, thanks in part to Stalin's purge of its officer corps. The administrative occupation of eastern Poland in the fall of 1939 strained Soviet logistics to the breaking point, and the disastrous Russo-Finnish War of 1939-40 demonstrated Soviet inability to coordinate units for a deliberate attack.²⁴ It is true that the Soviets eventually learned from their mistakes, redoubled their efforts, and forced the Finns to negotiate an armistice in March 1940. Nevertheless, the Red Army was a shambles.

In light of these experiences, during the period 1940-41 the Soviet government undertook massive reforms in military organization, equipment, command structure, and deployment. The Soviets mismanaged most of these changes, and none was complete by the time Germany attacked in June 1941. The Germans caught the Red Army in transition and ripped it apart.²⁵

For our purposes the most noteworthy Soviet change before the German invasion was the reintroduction of large combined arms mechanized formations. In reaction to the German victories of 1940, the Soviet government ordered the creation of mechanized corps, each consisting of two tank and one motorized rifle division, for use as the exploitation forces in each field army. By January 1941, the Red Army had on paper twenty-nine of these huge corps, authorized 1,031 tanks each. Unfortunately, the Soviets had neither the men nor the equipment to implement their ambitious plan. By removing all tanks from infantry and cavalry support units, the Soviets collected approximately 17,000 tanks, but the new organizations called for a total of 29,899. Worse still, these tanks were almost entirely the lightly armed and armored variety produced in the mid-1930s. By 1941, such equipment was tactically obsolete and mechanically worn out. In late 1939, the Red Army had tentatively approved designs for new, second generation equipment, including the T-34 medium and KV-1 heavy tanks. Yet incompetent management prevented production of more than 1,475 of these outstanding new weapons before the German attack.²⁶ Similar managerial and bureaucratic problems deprived the Soviets of trucks to move infantry and artillery, of mines to stop tanks, and of modern fighters to contest German air superiority.

In contrast to Soviet disarray, the German Army that invaded on 22 June 1941 was at the top of its form. Hitler's continuing

desire for more panzer divisions had unintentionally improved the balance of arms within those divisions. In order to assemble the tanks necessary for the additional divisions, the Germans had reduced all panzer divisions to an establishment of only two or three tank battalions of three companies each, for a total of 150-202 tanks per division. This action, plus an increase in infantry to a total of four trucked and one motorcycle battalion, meant that each division had six to nine tank companies, but fifteen motorized infantry companies; the other arms remained unchanged. Considering the high casualties and many demands for motorized infantry, this ratio was probably the most effective for all forms of mechanized combat.

Armored enthusiasts have frequently criticized Hitler for this reduction in tank strength, arguing that the resulting panzer division lacked the combat power for sustained advances of the type necessary in Russia.²⁷ It would be more accurate to argue that German planners geared the entire German Army for relatively limited distances and tied it to railroads and horsedrawn logistics. The problems in the German maintenance system, for example, had been evident even in the short Polish campaign of 1939. The Russian campaign involved much greater distances and longer operations. Under these circumstances, the German system of centralizing spare parts and evacuating most major repairs back to the factory was completely inadequate. In August 1941, the field commanders in Russia had to mount a major argument to convince Hitler to release 300 tank engines to replace those already worn out in the campaign. Every vehicle covered hundreds of miles over uneven and dusty roads, causing many breakdowns. If each panzer division had retained another tank battalion, those additional tanks would have worn out at the same rate as the rest of the division, leaving only a handful of additional vehicles still in the field by the time the division reached the gates of Moscow in December 1941. What the Germans needed was not so much more tanks as more trucks for resupply and a better field maintenance system to repair existing equipment.²⁸

These problems, however, were not immediately evident. Operationally, the 1941 campaign was the heyday of German blitzkrieg and especially of the encirclement battle. The Soviet analysis and description of these encirclements offers the best summary (see Figure 10).²⁹

First, the attacker had to penetrate or outflank the enemy's defenses. This was relatively easy in 1941, when the Germans caught the Soviets in their peacetime garrisons, unorganized for any coherent defense. Under these circumstances, the attacker

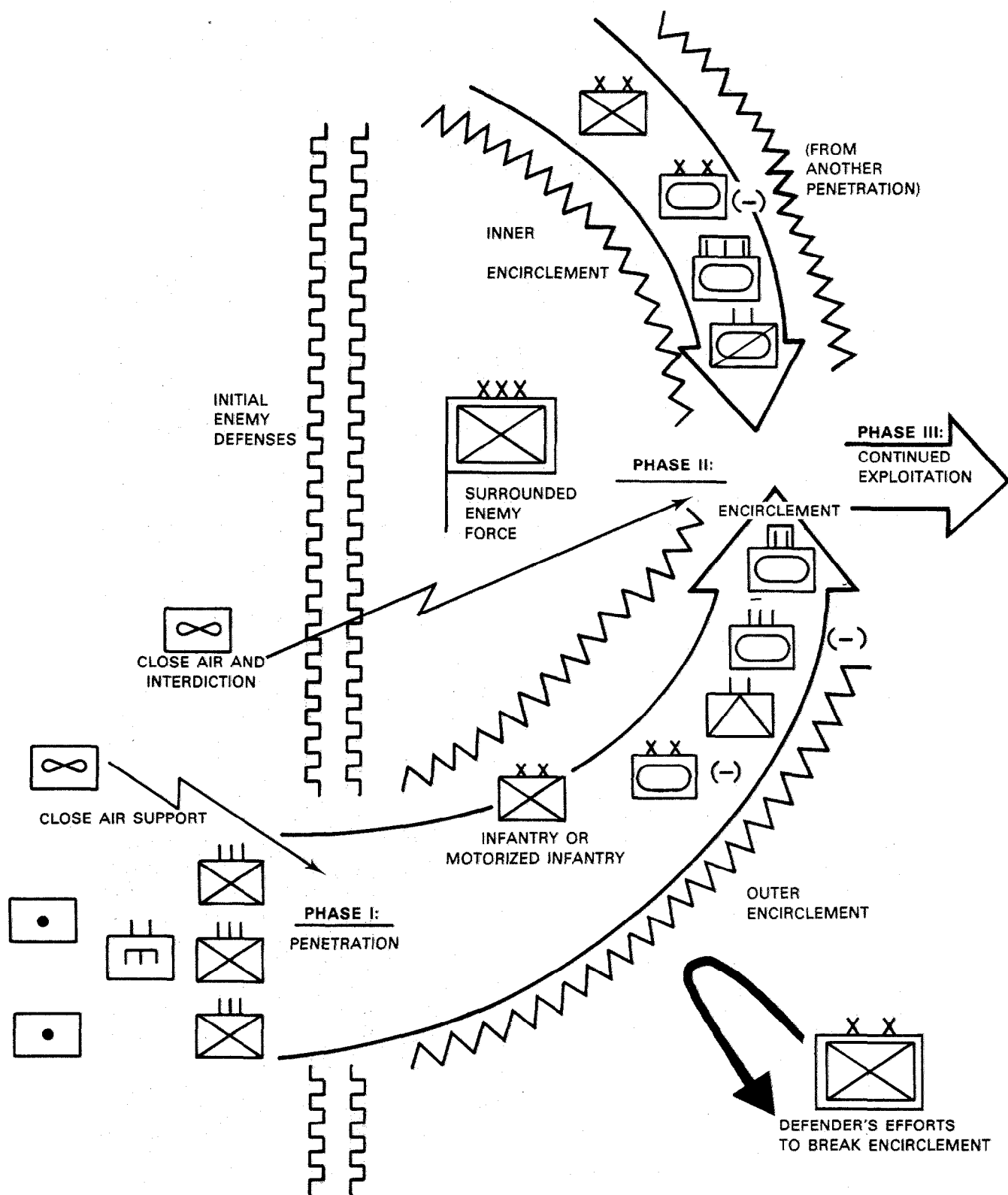


Figure 10. Schematic of Blitzkrieg Encirclement.

could exploit immediately with armored units. If a deliberate attack proved unavoidable, however, the Germans preferred to conduct the penetration with a conventional infantry force, supported by engineers to clear obstacles, with artillery and preplanned air strikes to suppress enemy defensive fires. As the war lengthened, such penetrations became increasingly difficult for all armies.

Next, once penetrations or flanking maneuvers had succeeded, the German armored forces sought to encircle the enemy in pincers. A combined arms battlegroup of battalion or regimental size usually led each pincer. After the jaws of the pincers closed, the attacker had to create two encirclements--one facing inward, to hold the surrounded force and gradually reduce it, and another facing outward, to ward off any efforts to relieve the encircled units. In order to establish these encirclements, the Germans tried to give each panzer corps one or more motorized infantry divisions to follow and support the two panzer divisions. In practice, the Germans never had enough force in a panzer corps to seal off the encirclements, so the process of holding and reducing encirclements had to wait upon the arrival of the foot-mobile infantry divisions. During the interim, surrounded Soviet soldiers and even entire Red Army units were able to infiltrate or break out of the loosely cordoned encirclement, escaping to join local partisans or to return to their own lines and fight again. This lag time also immobilized the panzer units, prevented further exploitation, and gave the defender time to reorganize his forces farther to the rear. Only when the infantry and logistics had caught up with the panzer units could the latter resume the exploitation and pursuit.

The Soviet Response, 1941-42

As the Germans advanced into European Russia, encircling one Soviet field army after another, the Soviet military took desperate measures to overcome their weaknesses. Two basic problems were immediately apparent. On the one hand, the average Soviet commander or staff officer lacked the skills necessary to orchestrate the different arms and weapons for an effective defense or counterattack. The general staff finally had to reprimand these commanders for continually deploying their forces evenly across the ground as if on a textbook exercise, without regard for the terrain or the high-speed avenues of approach that required antitank defenses-in-depth. On the other hand, the Red Army was seriously short of the specialized units and weapons that its commanders found so difficult to employ--engineers, tanks, antitank guns, and artillery.

The solution to both questions seemed obvious. Stavka (Supreme Headquarters) Circular 1, dated 15 July 1941, ordered the simplification of the commander's span of control by centralizing specialized units in pools at higher levels. This allowed more experienced commanders to mass them at the critical points. Specifically, the circular disestablished the rifle corps as a level of command. For the next two years, a Soviet field army consisted of only four to six divisions or separate brigades, plus specialized units such as artillery, tanks, and antitank weapons. Similarly, by the removal of tank and antitank units, and by a major reduction in artillery, the circular reduced the infantry division, which until that time closely resembled divisions in other European armies, from 14,483 men to only 10,859.³⁰ Much of this equipment only existed on paper in any case, and what was actually available was centralized at the level of field army or higher. The same order disestablished the huge mechanized corps of 1940-41. Some of the tank divisions within those corps were retained as separate formations, but in general the first German onslaught had already shattered the mechanized corps.

The remainder of 1941 was a desperate struggle for the Red Army, a struggle in which its traditional doctrines of deep battle and large mechanized units were inappropriate because of the German advantage in equipment and initiative. The few tanks coming off Soviet assembly lines were formed into small brigades used solely for infantry support.

Once the Red Army halted and threw the invaders back from Moscow in December 1941, the Soviet commanders began to revive their organization and doctrine.³¹ Soviet factories made a phenomenal production effort in the spring of 1942, enabling Col.-Gen. Yakov Fedorenko, chief of the Armored Forces Administration, to begin construction of new tank corps in April. By July, these corps had settled on an organization of one rifle and three tank brigades, plus supporting arms--a fairly tank-heavy force that the Soviets intended to use as the mobile exploitation unit for a field army (Figure 11). In the fall of 1942, Fedorenko added mechanized corps, which were more infantry-heavy and therefore more expensive in manpower and trucks. Truck production was in fact a major problem throughout World War II, and the Soviets depended upon imported American wheeled vehicles to move and support their mobile formations.

Unlike those of 1940, these 1942 Soviet "corps" were actually of division size or smaller. To conduct the deep exploitations of 150 kilometers or more envisaged in the 1920s, the Red Army needed a larger formation, on the order of a German panzer corps or panzer army. In May 1942, the Commissariat of Defense took the next logical step, uniting the existing tank corps into tank armies. The 1942 tank armies, however, were merely improvised

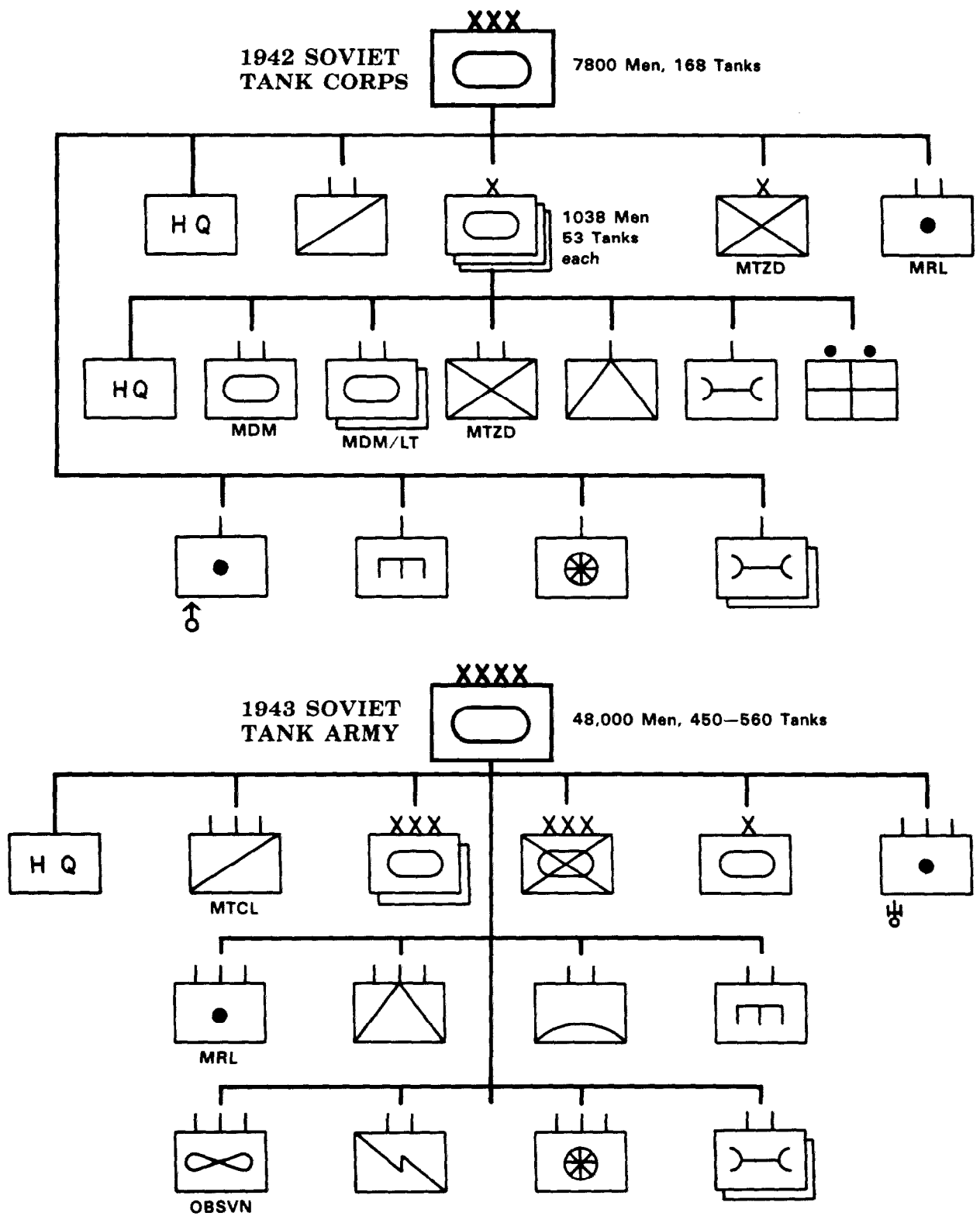


Figure 11. 1942 Soviet Tank Corps and 1943 Soviet Tank Army.

combinations of armored, cavalry, and infantry divisions, combinations that lacked a common rate of mobility and doctrine of employment. Moreover, these armies rushed into battle against the Germans during the summer of 1942 and were largely destroyed before they had even trained together.

Not until January 1943 did the Soviets finally produce a coherent tank army (Figure 11); the six tank armies formed in 1943 were the spearheads of all Soviet offensives for the remainder of World War II. Each of these new tank armies was actually a corps-sized formation in western terminology and, like the tank "corps," was extremely tank-heavy. This was probably an appropriate organization, both because of the open tank country of European Russia, and because of the high Soviet tank losses against the Germans. Given the inexperience of most tank crews and junior leaders in the Red Army of 1941-43, it was inevitable that the better trained German antitank and armor formations would inflict such disproportionate losses on the Reds. Thus, the Soviet Union's armored forces remained much more tank-heavy than those of other armies. Yet throughout the war, the Soviets also maintained corps-sized formation of horse cavalry, with limited tank and artillery support, for use in swamps, mountains, and other terrain that did not favor heavily mechanized forces.

The new mechanized formations must be understood in the context of their accompanying doctrine. During 1942, the Soviets digested the lessons of the first year of war and issued a series of orders to correct their errors. These orders greatly increased the effectiveness of the Soviet counteroffensive that encircled Stalingrad in November 1942. Senior Red commanders held conferences before Stalingrad to ensure that their subordinates understood the new doctrine.

The first problem was to penetrate the German defenses in order to conduct a counteroffensive. The initial Soviet counterattacks of December 1941-January 1942 had suffered from such dispersion that the German defenders often outnumbered their Soviet attackers. On 10 January 1942, Stavka Circular 3 directed the formation of "shock groups," concentrating combat power on a narrow frontage in order to break into the enemy defenses. Division and larger units were instructed to mass on narrow frontages in this manner. Stalin's Order 306, dated 8 October 1942, supplemented this directive by explicitly forbidding the echelonment of infantry forces in the attack. Given the continuing shortages of equipment and firepower, the Soviets decided to maximize their available force by putting almost all the infantry into one echelon. Thus, in a typical rifle division, as many as nineteen of the twenty-seven rifle companies would be on line for a deliberate attack.³² The German defenses in 1942 were stretched so thin that this forward Soviet

massing of infantry was more important than echelonment to sustain the attack. Later in the war, when both sides defended in greater depth, the Soviets tended to echelon their attack accordingly. Even in 1945, however, shallow German defenses prompted one-echelon Soviet attacks. Other orders in October 1942 governed the correct use of those tanks still assigned to assist the infantry assault. Because infantry commanders were still inexperienced, all such tank units were to be employed in mass under their own commanders.

Once the Soviets completed a penetration, their "mobile groups" would pass through for exploitation and encirclement operations, as described above. In effect, one such encirclement might include other, smaller encirclements within its pincers. Each field army attempted to use its own mobile group, composed of a tank, cavalry, or mechanized corps, to exploit penetrations to a relatively shallow depth of fifty or fewer kilometers, defeating the enemy reserves or linking up with a similar group from a neighboring army. Meanwhile, the tank armies acting as mobile groups for larger elements, such as a "Front" (army group), penetrated even deeper into the German rear areas. This, at least, was the theory. The first of these large, operational-level Soviet encirclements was in November 1942, when the German Sixth Army was surrounded at Stalingrad. In fact, the Soviet use of separate tank and mechanized corps in this battle may have been a test for the new tank army structure adopted two months later.

Thus, by late 1942, the German techniques for mechanized warfare had reached their peak, but were no longer meeting with the success of 1939-41. On the contrary, Great Britain and the Soviet Union had reorganized and retrained their own armies and were beginning to conduct their own successful mechanized offensives. Both German and British armored formations had become balanced structures where tanks no longer outnumbered the other arms. Moreover, all three armies were discovering the need for effective and mobile logistical support to make the mechanized offensives possible. The stage was set for a conflict in which logistics, technology, and defense-in-depth would determine as many battles as the armored division had decided in 1939-41.

CHAPTER FIVE

THE COMPLEXITY OF TOTAL WAR, 1942-1945

By deferring any consideration of the war in the Pacific, the previous chapter has reviewed the evolution of combined arms in World War II from the simple perspective of German advance and Allied response. The participation of the United States and the Soviet Union, however, made the war a much more complex affair, a war of production and technology as much as of battlefield maneuver. This chapter will identify those aspects of technology and tactics that affected the development of combined arms forces and doctrine during the second half of World War II. It will begin with the evolution of American force structure and doctrine, and then consider the changes in weapons design that made the latter half of the war so different from the first half. It will next survey the general trends in operational practice from 1943 to 1945 and conclude by examining the more complex and specialized questions of air-ground cooperation, airborne operations, amphibious landings, and special warfare units.

The American Response, 1941-44

Prior to the Japanese attack on Pearl Harbor in December 1941, the United States was an interested observer of World War II. Most of the U.S. Army did not become involved in major ground operations until the end of 1942 or even later. During the period 1941-42, however, the U.S. drew certain conclusions about the nature of weapons, organization, and tactics, and implemented those conclusions by continuing its evolution of the triangular infantry division and the 1940 armored division. Then, on the basis of maneuvers held in the U.S. and of initial combat experiences overseas, certain changes in American doctrine and organization occurred in the middle of the war. The resulting tactical system dominated American military thought into the 1950s.

In March 1942, Lt. Gen. Lesley McNair, one of the designers of the triangular division in the late 1930s, became head of Army Ground Forces, in charge of all unit training and organization. McNair continued to follow the concepts that had guided him in the 1930s, and thus the basic organization of the triangular division did not change significantly until after the war.¹

First, McNair wanted each unit to have only the minimum essential forces that it needed to conduct offensive operations in fluid, maneuver warfare against relatively limited resistance. In the case of the triangular infantry division,

this meant that the standard base of the division remained the three infantry regiments, four artillery battalions, reconnaissance troop, and engineer battalion developed in 1937-41.

On the other hand, a division did not need specialized units that were required only for specific situations or missions. This applied particularly to arms with an essentially defensive mission, such as antitank and antiaircraft artillery. These units that McNair "streamlined" out of the infantry division became a "pool" of specialized nondivisional companies and battalions, units that higher headquarters could attach to a division for a particular mission or else employ in mass at critical points on the battlefield. Thus the actual combat power of a division might change from day to day, depending upon requirements and missions. In December 1942, McNair extended this trend to form ad hoc task forces to nondivisional units by persuading the War Department to abolish all nondivisional regiments in favor of flexible groups. Nondivisional armor, antiaircraft, field artillery, mechanized cavalry, and combat engineer battalions all reported to group headquarters when not attached to divisions. Some group headquarters, notably those of mechanized cavalry, also acted as tactical control headquarters.² The number of battalions or companies subordinate to any group headquarters depended on the circumstances.

Another of McNair's principles was that staff and support elements must be as small as possible, in order to maximize the proportion of forces actually available for combat and to reduce paperwork and other organizational obstacles to rapid decision making and communication. Logisticians should bypass divisional and corps headquarters on routine supply matters in order to keep those headquarters small, mobile, and oriented on the tactical situation. Wherever possible, a specialist unit or person should have weapons to perform a secondary role as infantry or rear area security forces.

Finally, McNair sought to restrict as much as possible the amount of motor transportation in a unit in order to facilitate strategic deployment. The fewer vehicles that were organic to a division, the less shipping space that division would need when sent to Europe or the Pacific. For example, McNair sought to authorize only the number of trucks needed to shuttle necessary supplies and ammunition to the regiments during a twenty-four-hour period, rather than the number that could transport all necessary materials in one lift. Rifle units were not motorized, but could become so temporarily by the attachment of six truck companies to the division. Alternatively, if the division had attached elements such as a tank battalion, the

infantry could mount the tanks and the organic trucks borrowed from the artillery, allowing short-range motor movements with some loss in logistical support.

When the U.S. Army finally employed these concepts overseas, they proved only partially successful. Regardless of the terrain or enemy involved, most divisions in Europe and many in the Pacific believed that they needed tank, antiaircraft, "tank destroyer" (antitank), and nondivisional engineer support in virtually all circumstances. Corps and field army commanders who followed doctrine by shifting these nondivisional units from division to division according to the situation found that they could maximize the use of such elements only at the cost of much confusion and inefficiency. Attachment to a different division meant dealing with a different set of procedures and personalities before the attached units could mesh smoothly with that division. Once such a smooth relationship was established, the division was reluctant to release its attachments as ordered. In many instances, tactical commanders found it expedient to leave the same nondivisional elements attached to the same divisions on an habitual basis that might last for months. A typical U.S. infantry division in France during 1944 normally had attached battalions of tanks, tank destroyers, antiaircraft automatic weapons, and corps engineers. In some cases the division also had attached 4.2-inch mortars, transportation, and logistical support from the pools at corps and field army level. Thus, the triangular division in combat was much larger, more rigid, and more motorized than McNair had envisioned. An augmented infantry division of this kind might well have the mobility and firepower of a motorized division or even an understrength armored division, which goes far to explain the superior mobility of American infantry units when compared with standard German infantry forces.

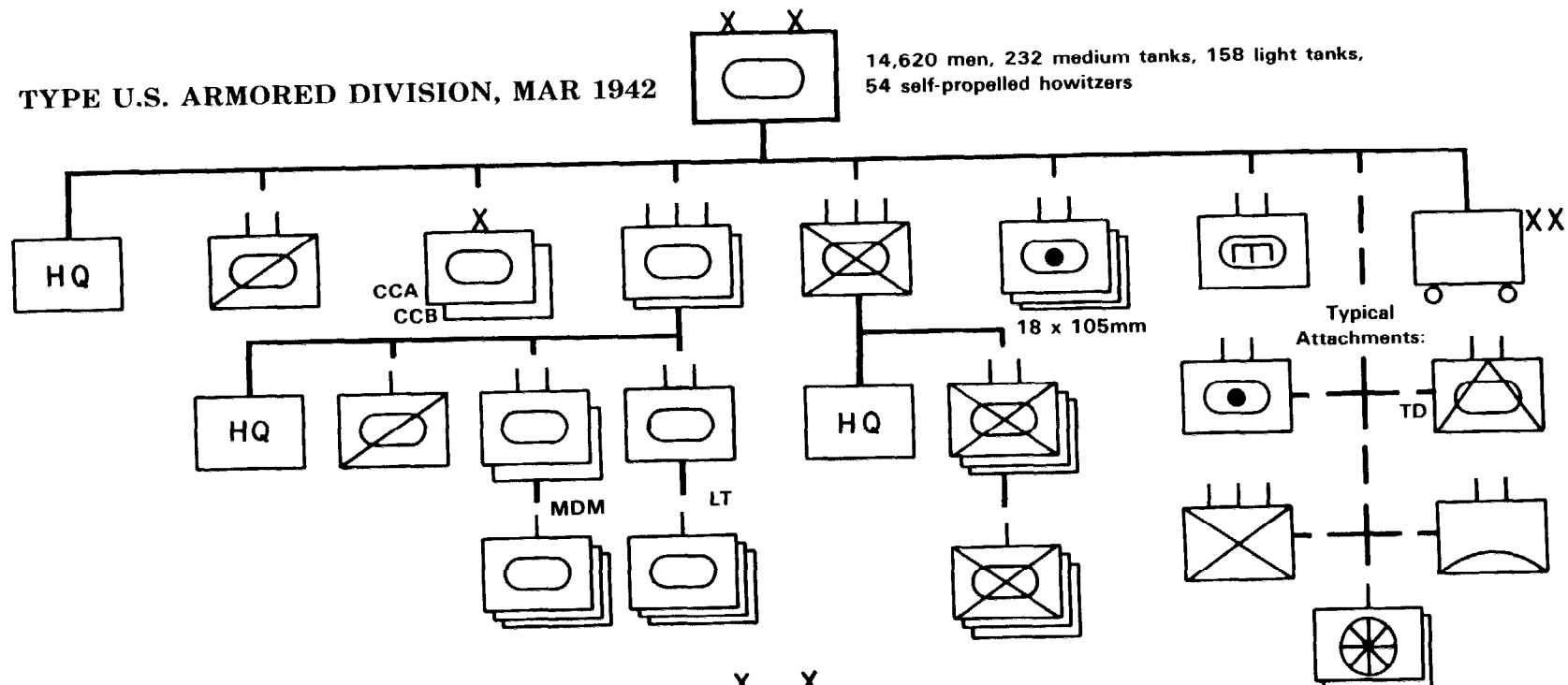
Many of these attached forces were subdivided and further attached to infantry regiments, as were the division's organic assets such as engineers and medical support. Minor changes in the regiment's organization in 1942 and 1943 had added six 105-mm howitzers, so that the regiment had its own artillery even without the direct-support field artillery battalion. In practice, a majority of infantry regiments normally operated as "regimental combat teams" (RCT). As a minimum, this meant that they had their share of the division's medical, engineer, and field artillery attached or in direct support. In addition, as noted above, many RCTs also had companies of tank destroyers, tanks, and self-propelled antiaircraft guns. Thus, the RCT was a combined arms force, a small division in itself.³

During the same period, the armored division underwent many more changes than the infantry division.⁴ Of the six different changes in armored organization during the war, two were most significant. As described earlier, the 1940 American armored division was composed largely of light tanks that greatly outnumbered the medium tanks, infantry, and artillery; this division also had several fixed headquarters designed to control only one type of unit, including the headquarters for armored and infantry regiments. When Maj. Gen. (later General) Jacob Devers became chief of the Armored Force in August 1941, he sought to establish a more flexible, functional organization. His efforts culminated in the reorganization of 1 March 1942 (Figure 12). This reorganization eliminated the armored brigade headquarters and established two "Combat Commands," A and B, as headquarters that might control any mixture of subordinate battalions given them for a particular mission. This was an American way to institutionalize the battle group concept that the German panzer forces achieved by improvisation. The 1942 organization also reversed the ratio of medium and light tanks, leaving the armored division with two armored regiments, each consisting of two medium and one light tank battalion. The new structure still had six tank battalions, but only three armored infantry and three armored field artillery battalions. This imbalance existed in part because the Armored Force planned to create a large number of armored corps which, like the German panzer corps, would have two armored and one motorized infantry division each.

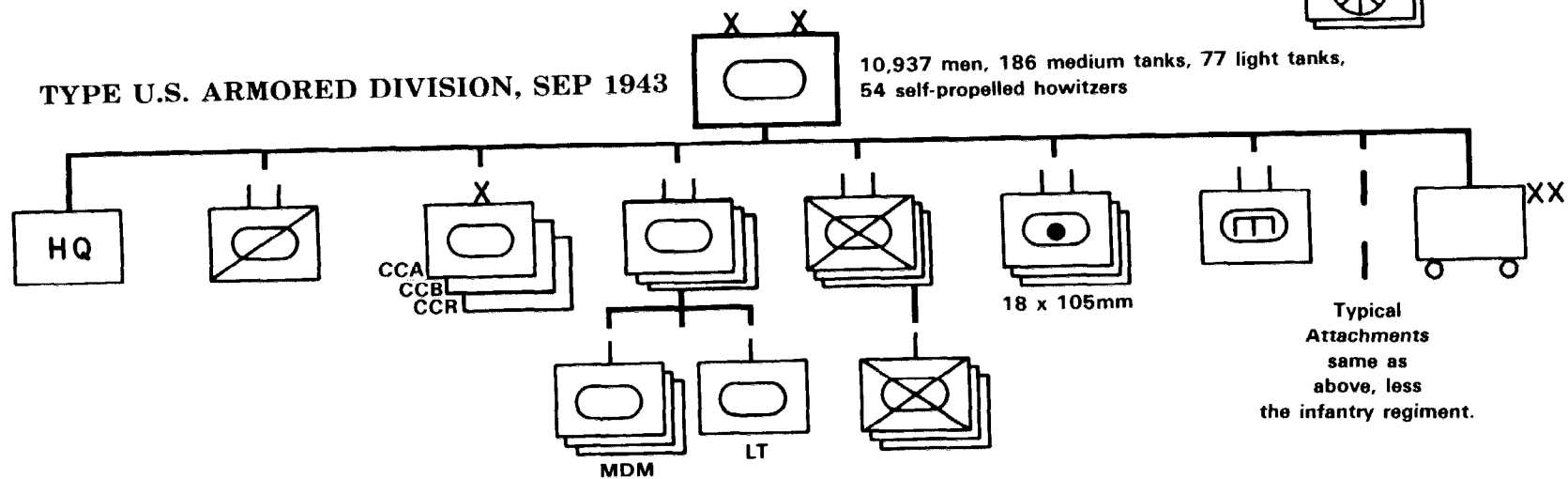
By early 1943, intelligence studies of the more balanced German and British armored divisions had reinforced General McNair's desires for a less cumbersome division structure. The one U.S. armored division used in the North African campaign never operated as a coherent division, but its dispersal into three or four different subgroups only illustrated the difficulties of controlling such a large formation. At the same time, the U.S. Army had dropped the concepts of an armored corps and motorized infantry division, making the imbalance of arms within the 1942 armored division structure even more significant. Technically, the U.S. light tanks had been no match for the increasingly well-armed and armored German vehicles, and therefore the U.S., like Britain before it, lost enthusiasm for the concept of deep raids by lightly armored vehicles.

As a result, in September 1943, the War Department announced a new, smaller armored division structure. This structure eliminated the regimental headquarters that had theoretically controlled only one type of battalion and reduced the tank component to only three tank battalions of four companies each. Thus, the 1943 structure had three battalions each of tanks, armored infantry, and armored field artillery, although in

TYPE U.S. ARMORED DIVISION, MAR 1942



TYPE U.S. ARMORED DIVISION, SEP 1943



practice there were twelve tank companies to only nine infantry. A third, smaller combat command headquarters, designated reserve or R, was added to control units not subordinated to the other two combat commands. Some division commanders used this "CCR" as a tactical control element like CCA and CCB.

Two U.S. armored divisions, the 2d and 3d, continued under the heavier 1942 table of organization throughout the war. Corps or army headquarters frequently reinforced each of these divisions with an infantry regiment borrowed from an infantry division. As a result, the balance of tanks and infantry in American divisions, as in the German and British armored divisions, came to be approximately equal. Both types of U.S. armored division received attachments similar to those given to infantry divisions. In addition, virtually every American armored division habitually controlled two quartermaster truck companies capable of handling the great logistical requirements of a mobile division.⁵

The actual task organization within each of these divisions varied greatly, but a typical combat command within a 1943 (light) armored division usually had two task forces. The combat command headquarters created these by trading a medium tank company from a tank battalion for an armored infantry company from an infantry battalion, producing one task force of three tank companies and one armored infantry company, and one task force of two armored infantry companies and one tank company. These battalion task forces also had attached platoons of tank destroyers, armored engineers, and in some cases self-propelled antiaircraft guns. An armored artillery battalion could be either in direct support of the combat command, or attached to that command if the division were widely dispersed.

Antitank Technology

Effective force structure and tactics are intimately related to effective weapons design, and therefore any study of combined arms warfare must consider the major effects of technology. During World War II, one obvious influence of technology on tactics was related to the entire question of tank and antitank warfare. Even if defenders managed to overcome their psychological fear of deep mechanized penetration, the blitzkrieg would still succeed unless the defense acquired effective antitank weapons and doctrine.

Antitank ditches and similar obstacles may slow the movement of armored units or channelize those units into anti-armor kill zones, but ultimately there are only two ways to defeat armored vehicles.⁶ Kinetic energy weapons penetrate armor plate by

sheer momentum, as if they were "punching" through the metal, while chemical energy weapons use explosive blasts to destroy the armor. Until the middle years of World War II, chemical energy weapons were usually ineffective against armor. Antitank design therefore concentrated on the kinetic energy weapon. Mathematically, the energy of an object is equal to one-half the product of the object's mass times the square of its velocity ($1/2 MV^2$); therefore improving the armor penetration of a kinetic energy weapon required increasing either its mass or its velocity, or both. Greater mass meant larger caliber weapons or heavier, denser material in the projectile. Thus, basic physics explains the general trend towards larger caliber weapons during World War II, although an increase in caliber alone would reduce the projectile's velocity unless the designer also took other steps. Velocity, in turn, would be increased through changes such as longer gun barrels, more effective propellants, and a better seal within the breech so that all the propellant effect went to drive the projectile out of the gun tube.

In practical terms, World War II improvements in antitank guns had three consequences: first, the size and weight of those guns increased steadily as calibers increased, gun tubes lengthened, and stronger carriages were added to absorb the recoil of high-velocity weapons; second, tanks needed increased armor to protect themselves from improved antitank weapons; third, these antitank weapons were much more effective than those of the previous decade, but they were also more expensive and specialized. Such weapons formed the backbone of any antitank defense, yet no army could afford to have antitank weapons organic to every small unit that might need them. The kinetic energy antitank gun simply did not fulfill the battlefield requirement that every unit must have some protection when it suddenly encountered enemy armor.

The alternative means of defeating armor was the chemical energy weapon. The detonation of an explosive charge usually had little effect against armor, because unless it were focused against the armor plate it had to destroy, the blast effect dissipated in all directions equally. Ordinary explosive artillery rounds had to be quite large before they could do more than damage the tracks and roadwheels of a tank, and medium artillery, like antitank guns, was too large and specialized to be of general use. Moreover, using field artillery in an antitank role diverted it from its primary function of indirect fire. The solution was to concentrate the effects of a relatively small amount of explosive on one particular point of the enemy's armor--the shaped-charge principle described in Chapter Four. Because the blast and not the momentum of the shell caused the destruction, the high velocity and elaborate gun carriage of a kinetic energy weapon were unnecessary for a chemical energy weapon.

By April 1942, the U.S. Ordnance Department had developed the 2.36-inch "bazooka," which fired a shaped-charge warhead with a rocket motor. Later that same year, the Germans captured an American bazooka from the Soviets, and from it developed the larger and more effective Panzerschrek antitank rocket launcher. The British PIAT (Projector, Infantry, Antitank) and the German Panzerfaust used the shaped charge propelled by a small conventional charge, similar to that of a grenade launcher. The same type of warhead enabled the Germans and Americans to develop experimental low-velocity recoilless rifles, which were light artillery pieces that eliminated the recoil by a controlled release of propellant blast behind the gun. Although recoilless rifles and rocket launchers lacked the long range and accuracy of conventional artillery, they gave the infantry, and indeed any unit, a much greater firepower and capability for organic short-range antitank defense.⁷

Tank Surrogates

Short-range antitank weapons were incapable of stopping a massed armor attack by themselves. Such weapons were most effective against the thinly armored flanks and rear of a tank that had already passed the defender. Towed antitank guns presented a small target for the enemy to detect and engage and could be maneuvered onto steep hills or river crossing sites where a self-propelled weapon could not go. The towed weapons, however, had very little armor; even if the enemy failed to score a direct hit on such an antitank weapon, a near-miss might cause casualties or at least disturb the gunner's aim. Many professional soldiers realized early in the war that the most effective antitank defense was a careful integration of obstacles, antitank mines, artillery, short-range antitank weapons, and some type of large caliber, longer-range antitank gun. This requirement for mobile, large-caliber antitank guns in the defense matched the continuing need for armor to support the infantry in the deliberate attack. Even if the nature of the enemy defenses did not always require tanks, the presence of tanks exerted a great psychological effect on both attacker and defender.

Armor experts in most armies, however, were determined to avoid being tied to the infantry, and in any event a tank was an extremely complicated, expensive, and therefore scarce weapon. The British persisted for much of the war on a dual track of development, retaining heavy tanks to support the infantry and lighter, more mobile tanks for independent armored formations. The Soviets similarly produced an entire series of heavy breakthrough tanks. Nevertheless, the widespread demand for tanks or tank-like vehicles outside of mechanized formations led

to a number of tank surrogates, weapons designed to provide armored antitank defense, close support of the infantry attack, or both. In the latter case, the surrogate needed considerable frontal armor and a dual purpose (antitank and antipersonnel) main gun.

The most original of these tank surrogates was the American "tank destroyer." One particular source of controversy about General McNair's force structuring system was the question of antitank defense. McNair did not accept the extreme view, common in 1940-41, that the armored division had rendered the infantry division almost obsolete. Instead, McNair agreed with the German concept that the best means to halt the armored division was an antitank defense integrated with infantry units. McNair and Col. Andrew D. Bruce of the War Department staff sought highly mobile antitank guns that would end the psychological threat of blitzkrieg by aggressive action against the attacking armored forces. After the successful experiments during the 1941 maneuvers, Bruce became head of a Tank Destroyer Center that developed its own doctrine for these weapons.⁸ While McNair had supported towed antitank guns on the conventional European model, Bruce wanted a high-velocity gun mounted on a mobile platform, sacrificing armor protection for speed and gunpower.

The 1942 tank destroyer battalions were combined arms forces in their own right, although they did not include a balance of all arms: each platoon had four self-propelled guns, an armored car section for security, and an antiaircraft section; in addition to three companies of such guns, the battalion included a reconnaissance company of three reconnaissance platoons plus a pioneer platoon. Ideally, when an armored penetration occurred, the tank destroyer battalions would mass to ambush the enemy tanks in the depth of the American defense. Within each tank destroyer battalion, the reconnaissance company selected likely anti-armor kill zones and emplaced minefields to impede the enemy advance through these areas. The gun companies would move to hull-down positions to reduce their vulnerability and then engage the enemy armor.

When the U.S. Army first encountered the Germans in Tunisia during 1942-43, the tank destroyers proved a dismal failure. Both tank destroyer doctrine and German armor design had outpaced the actual development of American tank destroyers, so that 1942 tank destroyers were little more than improvised guns mounted on half-tracks. The early tank destroyers lacked mobility and effective penetration power, the very characteristics that they were supposed to maximize. Moreover, most American units in North Africa were widely scattered, making it difficult to concentrate the tank destroyer forces according to doctrine. Finally, much of the North African terrain was too open for tank

destroyer vehicles to find effective hull-down positions. As a consequence, American commanders in Africa tended to favor the British system of towed antitank weapons and specifically asked that one-half of all tank destroyer battalions slated for the 1944 invasion of France use towed rather than self-propelled weapons. Once in Normandy, however, the Americans discovered that the towed antitank gun was almost useless in the more restricted terrain of Western Europe. Towed guns were not only slow to move, but too close to the ground to shoot over hedgerows and other obstacles. Furthermore, between Africa and Normandy, the Tank Destroyer Center had procured much more effective, properly designed self-propelled guns. The M18 model with a 76-mm gun and especially the M36 with a 90-mm gun were excellent weapons, although even the 90-mm had less penetration capability than the German 88-mm. Also by 1944, improvements in German armor had rendered the standard 57-mm antitank gun of the American infantry regiment largely ineffective.

The original tank destroyer battalions had developed from divisional antitank battalions, which the 1944 divisions lacked. Tank destroyer units consequently became even more important for antitank defense. As a result, in July 1944 the U.S. Army began to reconvert all tank destroyer battalions to self-propelled weapons. These newly converted battalions did not mass in accordance with Bruce's doctrine. The limited nature of the German armor threat in the west prior to the Ardennes counteroffensive of December 1944 made massed antitank defense seem unimportant. Instead, commanders wanted a few effective antitank weapons distributed to every unit, where they could defeat the small German armored counterattacks that were common at the time. In most cases, therefore, corps and army commanders habitually attached a tank destroyer battalion to each infantry division, and in turn division commanders attached tank destroyer companies to infantry regiments. The regiments used the tank destroyers not only as antitank weapons, but also as accompanying artillery and as substitutes for tanks to support their infantry attacks.⁹ Thus, the American tank destroyer units became a classic case of an arm that rarely functioned according to its doctrine, because that doctrine was never articulated clearly to field commanders.

In keeping with their doctrine of maneuver, U.S. tank destroyers usually had their guns mounted in turrets and, in fact, resembled tanks so much that they were often mistaken for such. In European armies, however, relatively few tank surrogates had turrets, because a turretless vehicle was much simpler and cheaper to produce. The absence of a turret gave German and Soviet tank surrogates a low profile that made them smaller targets on the flatter, open battlefields of Eastern Europe. This apparent advantage meant that the entire vehicle

had to turn in order to traverse the gun more than a few degrees. Thus tank surrogates were at a disadvantage if they engaged tanks or infantry from anything except an ambush position.

The Germans actually developed two series of tank surrogates--assault guns to support the infantry in situations where tanks were not available, and "tank hunters" (Panzerjaeger) for the antitank role. Both were distinguished from self-propelled indirect-fire artillery by considerably thicker armor protection and by a flat trajectory gun intended for direct fire. Although armor purists criticized the expenditure of resources to produce these hybrids instead of true tanks, such weapons performed a necessary role, particularly as the German towed antitank guns became progressively less effective against Soviet armor. The armored self-propelled tank hunter was much more survivable and mobile than its towed predecessor. The one drawback of all such weapons was that, unlike the towed antitank guns, they had difficulty accompanying the infantry into inaccessible areas such as steep hills or bridgeheads across rivers.

The Soviet Union also produced outstanding, heavily armored assault guns during the second half of the war, but tended to use those guns as one component of a three-way team in the deliberate attack. Medium tanks led the assault, using their mobility wherever possible to turn the flanks of German defensive positions. Heavy tanks, operating in pairs, advanced slightly behind the medium tanks, supporting the Soviet infantry and eliminating German strongpoints. In the event of a German armored counterattack, the heavy tanks would move forward to engage the German tanks head on, while the less protected medium tanks maneuvered to the German flanks. Finally, the assault guns provided accompanying artillery support for both infantry and tanks. To accomplish this direct-fire role, the assault guns began the battle in camouflaged positions from which they could overwatch the advancing tanks and infantry. The assault guns engaged centers of resistance that had survived the Soviet artillery preparation. This freed the assaulting forces to advance without halting to engage the enemy unless a counterattack appeared. At intervals, the assault guns bounded forward to new positions, always keeping within 500 meters of the heavy tanks and infantry.¹⁰ By staying behind in this manner, assault guns avoided meeting enemy armor in a maneuver battle at close range. In such a battle, tank turrets could traverse and fire much faster than the turretless assault guns could turn their entire vehicles to aim their guns. On many occasions, of course, the attacking Soviet unit did not have all three different types of armor, but the assault guns preferred to operate from an overwatch position in any case.

Tank Design and Production

These technological trends in antitank weapons and tank surrogates form a necessary background to the actual design and production of tanks during World War II. In general, both the armor and armament of tanks increased along with antitank technology, but different nations followed different design and production strategies. These factors exerted considerable influence on the battlefield.

During the war, German tank design went through at least three generations, plus constant minor variations.¹¹ The first generation, as already mentioned, included such unbattleworthy prewar vehicles as the Mark (or Panzerkampfwagen) I and II, which were similar to the Russian T-26 and BT series and to the British cruiser tanks. The Germans converted their tank battalions to a majority of Mark III and IV medium tanks after the 1940 French campaign, thereby stealing a march on the Soviets and British, who still possessed the obsolete equipment described earlier. However, the appearance of a few of the new generation T-34 and KV-1 tanks in Russia during 1941 compelled the Germans to begin a race for superior armor and gunpower. Simultaneously, their successes of 1939-41 encouraged them to rely increasingly on armor, rather than infantry, when conducting a rapid breakthrough attack. The German solution was to design third generation tanks that combined greater armor protection with the 88-mm antiaircraft gun that had proved so successful in the antitank role. The third generation included many different variants, but the most important designs were the Mark V (Panther) and Mark VI (Tiger) tanks. Unfortunately for the Germans, their emphasis on protection and gunpower compromised the mobility and reliability of their tanks. The automotive design of Mark V and VI tanks was notoriously underpowered and unreliable.

Moreover, Hitler and his assistants were fascinated with technological improvements and frequently stopped production to apply the latest design changes to the existing tanks. The fighting characteristics of German tanks remained current at the cost of interference with mass production. This interference, plus shortages of raw materials, meant that Germany could not compete in sheer numbers of tanks produced. In 1943, for example, Germany manufactured only 5,966 tanks, as compared to 29,497 for the U.S., 7,476 for Britain, and an estimated 20,000 for the Soviet Union.¹² A disparity in numbers of this magnitude would eventually overcome the highest quality in individual tank design. Similarly, the presence of so many different versions of the same tank, often within the same company or battalion, made it extremely difficult for the Germans to obtain spare parts and repair damaged equipment.

The alternative to constant changes in tank design was to standardize a few basic designs and mass produce them even though technology had advanced to new improvements. This was the solution of Germany's principal opponents. The Soviet T-34, for example, was an excellent basic design that survived the war with only one major change in armament (76.2-mm to 85-mm main gun) and various minor modifications. When the Soviets did introduce new designs, such as the heavier tanks and self-propelled guns of 1944, they did so without halting production of the older types.

The United States had even more reason to standardize and mass produce than did the Soviet Union. By concentrating on mechanical reliability, the U.S. was able to produce vehicles that operated longer with fewer repair parts. This helped alleviate the chronic shortage of shipping space when the army moved to Europe and the Pacific. To further ease the shipping problems and to ensure that American tanks were compatible with American bridging equipment, the War Department restricted tank width to 103 inches and maximum weight to thirty tons. The army relaxed these requirements only in late 1944.¹³

There was also a tactical reason for these restrictions. General McNair wanted to ensure that American tanks were designed in accordance with the U.S. doctrine for employing armored divisions. As already indicated, this doctrine foresaw tank destroyers, not tanks, defeating enemy armor. Chance encounters between tanks might occur, but the primary role of the armored division was to exploit and pursue, not fight enemy armor.

For all these reasons, the U.S. Army standardized on the M4 Sherman medium tank, an excellent compromise between reliability, mobility, armor protection, and gunpower. When the British first employed the Sherman in North Africa during late 1942, it proved to be at least equal, if not superior, to the German second-generation tanks, Mark III and IV. Once the Tiger tank appeared in Tunisia in early 1943, however, the Sherman tank and most of the U.S. antitank force seemed inadequate.

The width limitation further hampered the Sherman by forcing designers to give the tank narrow tracks. These tracks had much less mobility in muddy terrain than the wider tracks used by the Soviets and Germans. The M4's only advantages over later German tanks were superior reliability and a power-driven turret. During meeting engagements at close ranges this latter feature allowed the Sherman's crew to traverse their gun and engage the enemy more rapidly than could German crews using hand-cranked turrets. Sherman tank crews often carried a white phosphorus round in their guns to blind enemy tanks during such maneuvers.

Despite its drawbacks, the Sherman remained the main battle tank of the U.S. Army. In early 1945, apparently as a result of the large-scale German armored attacks during the Battle of the Bulge, the U.S. Army finally allowed a few heavy tanks of the T20 series to be sent to Europe for combat testing. The army's Ordnance Department had developed the T20 series in 1943, but considerations of doctrine, shipping, and mass production had prevented its use in battle until the closing days of the war.¹⁴

Great Britain also used the Sherman during the latter half of World War II, but was concerned by the limited penetrating power of the M4's 75-mm, medium-velocity main gun. After considerable discussions with the Americans, the British finally modified some of the Shermans they received. The British version of the Sherman, called the "Firefly," included the third-generation British antitank gun, the seventeen pounder (77-mm). This gun's long bore and higher velocity gave it much greater capability against German armor.¹⁵

Signals Intelligence and Communications

In addition to the tank and aircraft, another piece of technology came of age during World War II. Signals intelligence, or SIGINT, was yet one more instrument or arm that the commander had to integrate and coordinate with others. Recent histories of the war probably have overstated the strategic importance of SIGINT, while they have understated its tactical role. An army's ability to plan for future operations and concentrate the different arms at the decisive location depended in part on such intelligence.¹⁶

Ultra, the British codeword for intelligence based on decoding highly classified German radio messages, gave the western Allies only limited access to German military intentions and capabilities. The German Army normally used secure landline communications for high-level messages, except when fluid operations forced them to make radio transmissions. Even then the Allies did not necessarily intercept, let alone decode in a timely manner, every German message. The Germans changed their code every twenty-four hours and periodically made major shifts in codes or equipment. The Allies might go for days or even months without being able to decode transmissions on specific radio networks. On 1 May 1940, for example, Germany changed virtually all its codes, blinding the Allies' SIGINT effort until 22 May, by which time the German offensive through the Ardennes had succeeded.¹⁷ Similar problems recurred during most of the war.

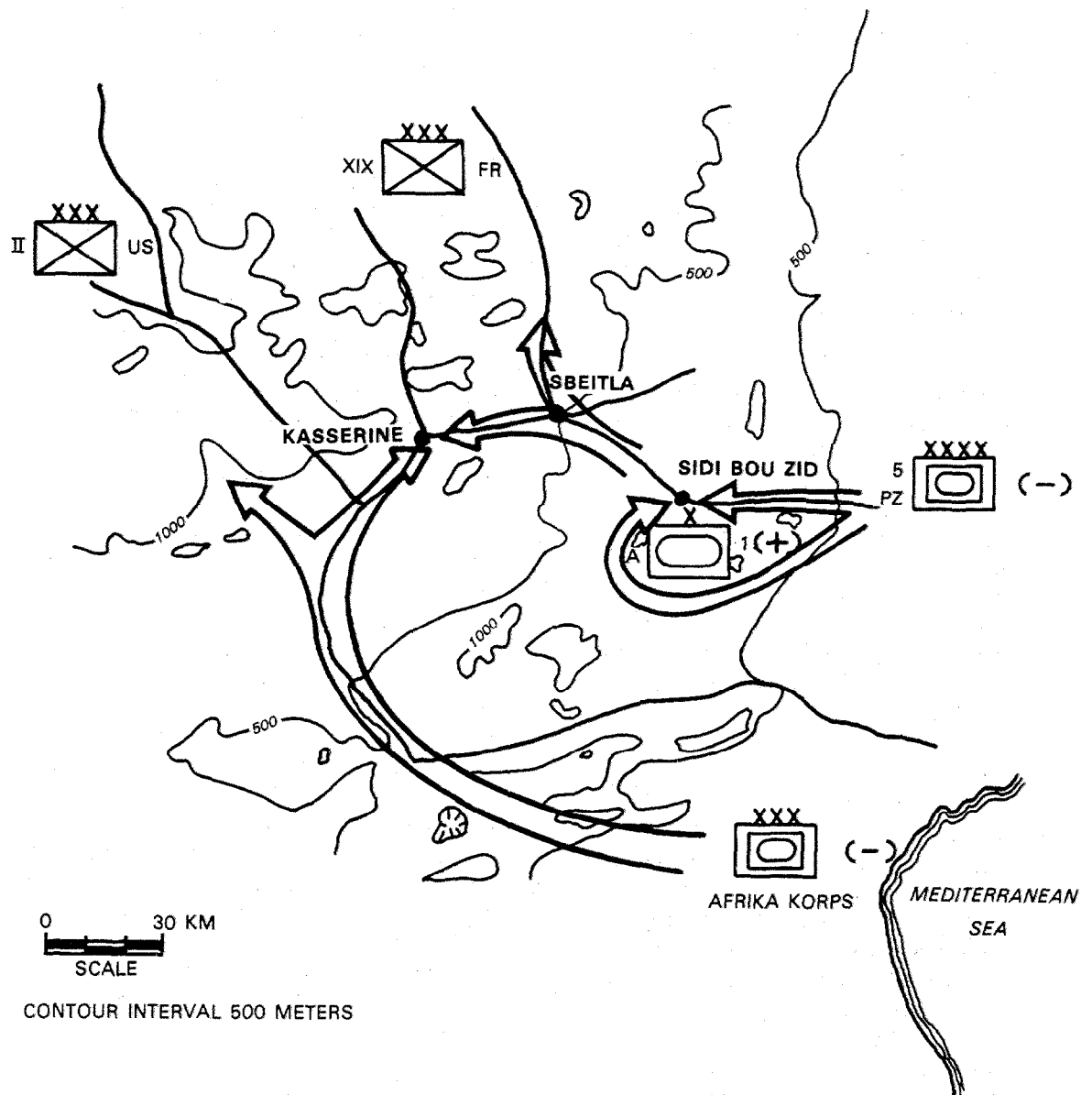
Nor were the deciphered messages of Ultra always illuminating for the tactical and operational situation. Only rarely did the most senior German commanders communicate their specific plans, except where Hitler was personally interfering in operations and required detailed reports. Intelligence analysts pieced together much of the most valuable Ultra information over long periods, or inferred capabilities on the basis of logistical messages. Moreover, few Allied commanders below field army level had access to this information.

The worst drawback of Ultra-level SIGINT was that it discouraged the use of other sources of intelligence collection that might confirm or deny Ultra information and blinded Allied commanders to threats that were not discussed in German radio traffic. In early 1943, for example, the Allied forces in Tunisia relied heavily on Ultra; their other intelligence collection means were improvised and largely ineffective. The German offensive of Sidi-bou-Zid-Kasserine Pass in February 1943 (Map 6) surprised the Allies because available SIGINT indicated that higher German headquarters had disapproved such an operation in favor of an attack elsewhere. Of course, SIGINT could not know that Rommel and other German commanders had met face-to-face on 9 February and had developed a plan that led to the attack on Sidi-bou-Zid. This attack mauled a dispersed U.S. armored division.¹⁸ Lack of SIGINT and misinterpretation of available intercepts also had a considerable effect on Allied failure to predict the scale and intensity of the German counteroffensive in the Ardennes in December 1944.

Although the western Allies held a priceless asset in the strategic intelligence they received from Ultra, for much of the war German SIGINT was more effective at the tactical level. From 1940 to 1942, for example, a single Horch (listening or intercept) company in North Africa skillfully interpreted the unencrypted tactical communications of British units, giving Rommel a complete picture of enemy dispositions and intentions during battle. When the British finally became aware of this unit's activities in July 1942, an Australian battalion raided and captured the company. German replacements could not replace the expertise of the analysts lost in that company and thus had more difficulty detecting later British deception operations.¹⁹

By contrast, relatively little information is available concerning Allied tactical SIGINT, including the British "Y" Service and American "Radio Intelligence." German tactical communications were often unencrypted, or used easily deciphered code systems. From a miniscule prewar basis, the Allies had to develop their knowledge of German tactical radio networks and

TUNISIA



Map 6. SIDI BOU ZID-KASSERINE PASS, February 1943.

procedures. In terms of offensive electronic warfare, the Allies had a number of notable successes. During the evacuation of Dunkirk in 1940, the British effectively jammed German bomber communications, hampering Luftwaffe attacks on the retreating British forces. Two years later, when Montgomery launched the second Battle of Alamein, airborne jammers disrupted German tactical radio communications for hours.²⁰

The development of effective tactical radio communications was the basis for controlling fluid, mechanized operations as well as the raw material for tactical SIGINT. The demand for such communications greatly accelerated research and development in this area. In particular, the U.S. Army pioneered the use of frequency modulation (FM) radios for short-range tactical communications, and both very high frequency (VHF) and ultra high frequency (UHF) radios for longer range communications.²¹ Unlike the European armies, the U.S. Army used FM extensively, because it provided static-free signals over a wide variety of channels without using a separate crystal for each frequency.

The combination of reliable radio communications with efficient tactical signals intercept services also provided a new opportunity for senior commanders to follow the course of battle without delays in the communications system. Both the British and American armies developed means for senior headquarters to receive battle reports by radio without waiting for the messages to be processed through intermediate layers of command. That is, the senior headquarters could monitor tactical unit radio networks directly, or else assign a radio-equipped liaison detachment to each forward unit to report the situation to the senior headquarters. The British GHQ Liaison (Phantom) units and the American Signal Information and Monitoring (SIAM) companies performed this service admirably during 1944-45, and in the British case as early as 1942. The danger with such a monitoring system, as Gen. Dwight D. Eisenhower noted after the war, was that the senior commander might be tempted to bypass the intermediate headquarters and interfere directly in the battle, using the system for command rather than as a source of timely operational and intelligence information.²² In the latter role these monitoring services enabled much more effective coordination of the battle, allowing the commander to react through his subordinate commanders to situations as they developed.

Soviet Concepts and Practice, 1943-45

Many of the foregoing technological considerations became evident on the Eastern Front, beginning with the Battle of Kursk in July 1943. The last great German offensive in the east ran directly into an elaborately prepared Soviet defense organized

around antitank strongpoints established by all units of company size or larger. The German blitzkrieg stalled because it was unable to achieve the initial penetration of the enemy's defenses--Soviet antitank defenses were simply too strong and, above all, too deep for the Germans to breach without catastrophic losses. If anything, the Germans played into Soviet hands by leading their attack in some areas with massed armor, instead of a more conventional infantry-artillery-engineer-tank attack to create the breach. The Germans apparently led with massed tanks in an effort to increase the tempo of the penetration, but without decisive numerical superiority the result was a disaster.

After Kursk, the Soviet Union held the initiative, although it was not always attacking the Germans and their Axis allies on all fronts. Generally speaking, the Soviets exerted tremendous efforts to penetrate the deep German defenses. In the ensuing exploitation, logistical restrictions usually caused the Soviet offensive to grind to a halt even where there was little German resistance. In the course of the war, improvements in Soviet logistics led to steady increases in the depth of exploitation. Once the Germans gained a respite to reorganize their defenses, the cycle repeated itself. Accordingly, the Red Army developed a variety of techniques for both penetration and exploitation against the German defenders.

One significant development during 1944 was the change in Soviet reconnaissance techniques before a deliberate attack. Prior to that year, the Red Army had been very effective in conducting small, time-consuming long-range reconnaissance patrols. To shorten the time required to prepare for a new offensive, the Soviets in early 1944 sent out experimental company- and battalion-sized units to engage the German outposts or reconnoiter by fire, thereby identifying the main German defensive organization much more rapidly. In the process, the Red Army received an unexpected bonus. Soviet reconnaissance units were often able to seize control of outposts that the Germans were defending only lightly, as part of the long-standing German doctrine of defense-in-depth. By late 1944, the Soviets had transformed their reconnaissance units into the first wave of the deliberate attack. Company and larger units on reconnaissance missions attacked within a few hours of the main offensive, seizing the German outposts and thereby unmasking the main German defenses. Then the main attack focused on those principal defenses.²³

Although Soviet commanders massed their forces on relatively narrow breakthrough fronts, their successes were due to more than just numerical superiority. Whether in the reconnaissance echelon or the main attack, the Soviets used a variety of

procedures to overcome German defenses. First, artillery units fired their preparations under centralized control and according to elaborate plans. The Soviets used a variety of deception measures, such as sending the assault infantry forward during a lull in the firing in order to lure the Germans out of their bunkers so that renewed Soviet artillery fire could destroy them. Heavy tanks to support the infantry and eliminate strongpoints, medium tanks to penetrate rapidly and suppress enemy infantry fires, and assault guns for direct-fire support against antitank guns and strongpoints cooperated as described earlier. Combat engineers or specially trained infantrymen frequently rode on each tank. Their mission was to eliminate obstacles and provide close-in protection for the tank from German short-range antitank weapons.²⁴ The tank might temporarily assume a hull-down position and provide covering fire while engineers cleared minefields and infantry eliminated enemy short-range antitank weapons.

The Soviets reluctantly accepted the high casualties produced by this technique in an effort to accelerate their rate of penetration. Given the meticulous German defensive preparations and the lack of Soviet armored personnel carriers, the Soviets had to combine engineers, infantry, and tanks in this manner, regardless of losses. Soviet commanders may have used battalions of "expendable" criminals for these tasks. In general, however, by 1944 casualties were a subject of great concern for the Soviets. The best means to reduce casualties were concentration, speed of penetration, and careful task organization of the attacking forces. Instead of advancing on-line and in mass, the Soviet attackers operated in tailored assault groups of platoon to battalion size (Figure 13). Where time allowed, each assault group trained to eliminate a specific German strongpoint, thereby dislocating the German defensive organization. Assault groups normally included four subgroups: a reconnaissance subgroup to clear an approach route to the objective, a blocking subgroup to engage and pin down the defenders, a fire subgroup to isolate the strongpoint from reinforcement, and an attack subgroup, including engineers and heavy tanks or assault guns, to eliminate the objective from the flanks or rear.²⁵

Once the Soviets completed their penetration, their commanders sought to sustain the momentum, moving rapidly from encirclement to renewed exploitation and pursuit so that the defenders had no opportunity to reorganize a coherent defense. German exploitations of 1939-42 had normally been centrally controlled, to ensure that all elements moved in the same general direction and were available to support each other in the event of counterattack. Soviet exploitation, particularly after the initial encirclement was completed, tended to be more decentralized and diffuse. Notoriously poor Soviet radio

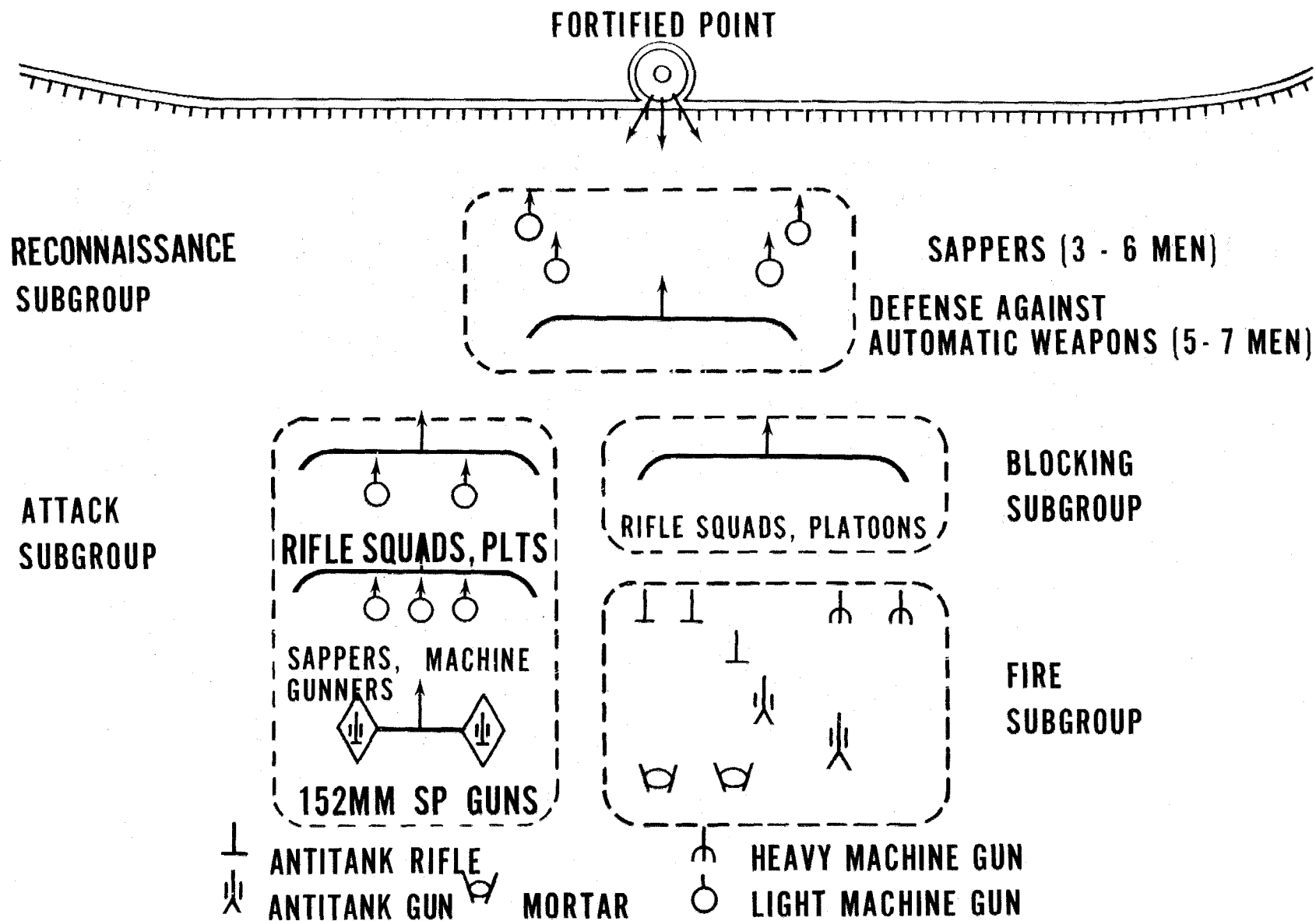


Figure 13. Soviet Assault Group Formation, 1944-45.

communications may have been partially responsible for this decentralization, but more to the point the Soviets retained their belief in the interwar theory that rapidly moving forces could fan out and confuse as well as disorganize the defender. Decentralization and small-unit initiative allowed leading Soviet units to seize targets of opportunity, such as bridges and river crossings, that were not immediately obvious to the senior planners. The same decentralization made the Soviets more vulnerable to defeat in detail by massed German counterattacks. Beginning in 1943, a combination of factors, including declining German combat effectiveness, growing Soviet tactical experience, and better close air support of the exploitation forces allowed the Soviets to defeat most German counterattacks and continue their mission.

The most common formation for Soviet exploitation was the "forward detachment," a combined arms organization of great mobility and firepower that was sent ahead of the main unit to seize key objectives and disrupt enemy efforts to reorganize the defense.²⁶ During the war, both the size of the typical forward detachment and the distance it operated ahead of the main body increased steadily. In the last two years of the war, a forward detachment normally was a tank brigade reinforced by batteries or battalions of field and antiaircraft artillery, heavy tanks, assault guns, and engineers. When available, an air controller accompanied the detachment to direct close air support, and air units were dedicated to support specific detachments. This reinforced brigade operated as much as ninety kilometers ahead of the rest of its parent tank corps, which, in turn, might be acting as a forward detachment for a tank army. A forward detachment did not necessarily follow the same routes as the main body of troops and was not responsible for advance guard security of that main body. Frequently, an efficient forward detachment commander could brush through hasty German defenses along the way, allowing the following troops to continue their exploitation and pursuit without deploying to attack the scattered Germans. When logistics and lack of combat power finally halted a forward detachment, the detachment commander attempted to seize a bridgehead over the next river obstacle as a starting point for a renewed offensive at a later date. In short, the forward detachment led the mobile group envisaged in prewar Soviet doctrine and greatly increased the tempo of exploitation and pursuit.

The German Decline, 1943-45

While the Red Army grew in both equipment and tactical proficiency, the German Army declined not only in numbers but in overall training and tactical ability. When faced with local Soviet superiority achieved by massing on a narrow breakthrough

frontage, German defenders naturally ascribed all Soviet successes to overwhelming numerical advantage. In reality, the quality of the German armed forces declined as a result of their declining quantity. As early as the summer of 1942, the German divisions that were not involved in the second German offensive in the east were deliberately filled to only 55 percent of authorized personnel. Even spearhead units received only 85 percent of authorized equipment.²⁷ In order to maintain their armies in the field, the German leaders progressively reduced the amount of training given to replacements and used training units in combat during Soviet breakthroughs. This became a vicious cycle, in which poorly trained German soldiers survived for only short periods at the front and had to be replaced even more rapidly than before.²⁸ This decline in infantry quality prompted German commanders to seek ever-increasing amounts of firepower in the form of assault guns, antitank rockets, automatic weapons, and artillery.

Given shortages of personnel, many German infantry divisions operated with only six instead of nine infantry battalions from 1942 onwards. In 1944, the German General Staff formally changed the division structure to reflect this reality. According to the 1944 reorganization, an infantry division consisted of three infantry regiments of two battalions each. This configuration allowed each battalion to have a greater share of the weakened regimental artillery and antitank companies than had been possible with a three-battalion regiment. On the other hand, such a structure retained the large overhead of three regimental staffs and support elements, yet denied the regimental commander a third battalion to act as a local reserve force. In practice some divisions organized themselves into two regiments of three battalions each. In either case, the 1944 German infantry division retained all four artillery battalions of the previous structure, so that, at least on paper, the declining ability of the infantry was offset by a larger proportion of fire support. Recognizing enemy air superiority, the 1944 divisional organization also included a battery of self-propelled antiaircraft guns.²⁹

Despite such improved fire support, after 1943 the German defenders found themselves increasingly hard pressed to contain, let alone halt, Soviet offensives. The basis for the German doctrine of defense-in-depth was to absorb enemy attacks and separate armor from its supporting infantry, in order to defeat each element independently. By 1944, improved Soviet cooperation among the arms nullified German efforts to isolate those fighting components from one another. Many German commanders experimented with the idea of a preemptive withdrawal, pulling back their troops just before a Soviet deliberate attack in order to save lives and to force the Soviets to reorganize for another attack a

few kilometers farther west. Yet such a withdrawal under pressure required high morale and well-trained troops, the very commodities that were declining most rapidly in the German Army.³⁰

While the infantry divisions gradually wore down, the Germans made a belated effort to rebuild their panzer forces. Heinz Guderian dedicated himself to this task as Inspector-General of Panzer Troops (1943-44) and then as Chief of the General Staff (1944-45). However, his continued insistence on the panzer arm as a force separate from the rest of the German Army was no longer appropriate. It was true that panzer divisions were the principal German instrument for counterattacking enemy penetrations and encirclements. Yet these divisions were so few in numbers compared to the great distances on the Russian front that they often counterattacked singly or in pairs, wearing themselves down as fast as Guderian could rebuild them. By removing armor training and doctrine from the appropriate branches of the General Staff, Guderian only increased the estrangement between the panzer and infantry forces and made training between the arms more difficult.³¹

Despite these problems, the balanced panzer division remained an extremely effective force at the tactical level. Only minor changes in organization and tactics occurred after 1941. Production requirements for tanks, assault guns, and other tracked vehicles meant that the panzer grenadiers remained largely motorized, rather than mechanized, throughout the war. Even at its peak in the fall of 1943, the German panzer force had only 26 of 226 panzer grenadier battalions, or 11 percent, mounted in armored half-tracks.³² Thus, except in certain elite units, no more than one of the four to five infantry battalions in a panzer division was actually mechanized. Generally speaking, one or two companies of such a mechanized battalion accompanied each panzer battalion in advance, with the motorized infantry following later to consolidate and defend the areas seized by the first attacks. Artillery forward observers in tanks or half-tracks accompanied the first wave. Where only motorized infantry was available, these troops went into battle dismounted, following in the lee of the tanks until they were needed to clear obstacles or defend against enemy infantry. To avoid being tied to this dismounted infantry when the attackers met with effective fire, the German tanks sometimes bounded forward, assumed hull-down positions that minimized the target they presented to the enemy, and provided suppressive fires to cover the infantrymen hurrying to rejoin the tanks. To protect the attacking panzer force from enemy armored counterattack, antitank guns leapfrogged into a series of overwatching positions on the flanks of the advance. Assault guns remained with the motorized infantry reserves to consolidate gains or to engage an

enemy counterattack that penetrated into the division mass. Because of Allied air superiority on all fronts, German armored forces needed much greater air defense protection in 1944-45 than in 1940. Truck-mounted panzer grenadier battalions therefore included the 20-mm antiaircraft guns that had proven so effective earlier in the war, while tank and half-track mounted infantry received self-propelled antiaircraft guns, in some cases as low as company level.³³ Such, at least, was the theory of panzer organization and tactics; in practice, of course, the declining strength of such units produced a variety of improvised battle groups.

American Concepts and Practice, 1943-45

The initial contact of American forces with Axis troops did not fulfill the promise of previous U.S. developments in doctrine and organization. During the 1942-43 invasion of North Africa a variety of factors, including inexperience, led American commanders to scatter their forces in regimental or smaller units, thereby depriving them of the advantages of the American centralized fire control system. The U.S. armored divisions had stressed decentralized, mobile combat by direct fire so often in training that their self-propelled artillery battalions had neglected the study of indirect-fire techniques. Inadequate logistics forced the Americans to leave their corps artillery far behind the front in Tunisia, further reducing available fire support when the Germans counterattacked in February 1943. In the crisis of Kasserine Pass, however, the artillery of the 1st and 9th Infantry Divisions was finally able to operate on an organized basis, with devastating effect on the Germans (Map 6, above).³⁴

Similar problems arose in the Southwest Pacific, where in 1942 General Douglas MacArthur committed the 32d Infantry Division to battle in Papua with no artillery and only a few mortars. Despite the protests of the 32d Division commander, MacArthur's staff mistakenly thought that artillery would be ineffective in the jungles. Moreover, the local air commander, Gen. George C. Kenney, assured the division that "the artillery in this theater flies," and then failed to provide effective air support throughout a long campaign.³⁵ Weather and terrain prevented such air support on many occasions, and there was so little communication between air and ground that Kenney's pilots attacked Americans by mistake on a weekly basis. Based on the bitter experience of assaulting Japanese bunker complexes without appropriate fire support, the 32d Division learned at great cost the need to coordinate artillery and air support with the infantry.

To some extent the U.S. troops who invaded Normandy in 1944 had to relearn this lesson. Many of the U.S. infantry divisions used in the invasion had not been in combat before and had not had the opportunity for extensive tank-infantry training with the separate tank battalions that supported them. Furthermore, the radios issued to infantry, tank, and fighter aircraft units had incompatible frequencies, making communication among the arms impossible. Even when the infantry commander was riding on the outside of a tank or standing next to it, the noise of the tank engine made it difficult for the infantry and tank commanders to communicate face-to-face.³⁶

The U.S. Army gradually corrected these problems and developed more effective combined arms teams during the breakout from Normandy. The need for close tank-infantry cooperation reinforced the habitual association of the same tank battalion and infantry division. Signalmen installed improvised external telephones on tanks, so that the accompanying infantry could enter the tank intercommunications network. In July 1944, the commander of IX Tactical Air Command, Gen. Elwood A. Quesada, provided VHF aircraft radios for installation in the leading tanks of each armored task force. When the U.S. broke out of Normandy beachhead, these tanks could communicate with fighter bombers. The IX Tactical Air Command flew "armored column cover," providing on-call fighter-bombers for close air support. It is true that this tactic was very wasteful of air resources, but the high tempo of exploitation that these tank-aircraft teams could maintain justified the expenditures.

Advancing on parallel routes also facilitated American exploitation and pursuit across France. Where the road network allowed, U.S. armored divisions and combat commands advanced with two or more task forces moving along parallel routes. Frequently, a German strongpoint would halt one column, only to find itself outflanked by another American column a few kilometers away. These tactics and massive air superiority propelled the Allied advance. The Allied forces usually found their progress hindered as much by logistical factors as by enemy defenses. Strategically, logistics hampered the Allies throughout 1944-45. Tactically, some armored units found it more secure to travel with their combat trains in the midst of the column, rather than following behind where they might encounter bypassed enemy resistance. Of course, such a tactic was only appropriate when exploiting against limited enemy defenses. When logistics elements moved on their own, they often required small antiaircraft, tank destroyer, and infantry escorts for local security.³⁷

This dispersion of antiaircraft units in small detachments exemplified the fate of specialized American forces when their particular function was not in demand. Although U.S. antiaircraft units conducted a number of air defense operations, most notably the protection of the bridge at Remagen during the conquest of Germany, overwhelming Allied air superiority made an integrated air defense system increasingly unimportant during 1944-45. Instead, senior commanders used antiaircraft weapons in a ground fire-support role and deactivated some antiaircraft units to provide much needed infantry replacements during the fall of 1944. Similarly, chemical smoke generator companies repaired roads when line units did not need smoke support. This misuse developed a set of false attitudes and priorities among combat commanders, but the shortage of manpower was so severe that no unit could stand idle. The excellent performance of such specialized units in an infantry role during the Battle of the Bulge justified the American policy that support troops should be trained and equipped to defend themselves and fight when necessary. Even if, for example, the engineers had been employed to construct barriers in front of the German advance, there were no other forces available to provide firepower in conjunction with those obstacles. At that point, the situation was so desperate that local commanders were fully justified in using all available forces as infantry.

Air-Ground (Non)Cooperation

Air support of ground operations, and especially close air support, was the subject of intense controversy between ground and air services during World War II. No one disputed the importance of air superiority, but ground attack priorities were another matter. That controversy was perhaps most acute in the United States, but the questions involved found echoes in other nations as well.

Throughout the war, the U.S. Army Air Forces (AAF) operated almost independently from the other elements of the Army. Soon after Pearl Harbor President Franklin D. Roosevelt gave the AAF a tremendous mission--precision strategic bombing of Germany and eventually Japan--that strained the limited air resources of the U.S. for most of the war. AAF leaders believed strongly in the value of strategic bombing. This belief only increased their tendency to distance themselves from the ground arms. The result was near disaster on the battlefield, retrieved only by the common sense of tactical commanders on the spot.

Army Air Force doctrine defined three priorities for tactical aviation: first, air superiority; second, "isolation of the battlefield," which in effect meant air interdiction; and third, attacks on ground targets "in the zone of contact" between

opposing armies.³⁸ Throughout the war, the AAF phrase for close air support was "third phase" or "priority three" missions, reflecting a basic belief that such targets were an uneconomical, inefficient, and unimportant use for air power, and rightfully belonged to the field artillery. Some basis for this belief existed, of course--close air support required extremely careful training and coordination and suffered from the difficulty of differentiating friend from foe while flying at high speed. Moreover, the air leaders were probably correct in their belief that the air weapons of World War II had only limited destructive effect against small, point targets of the type found near the line of contact. Centrally directed interdiction of the enemy by tactical air assets, the AAF argued, was the most efficient use of this weapon. Yet the ground commanders valued the psychological effects of close air support on both friend and foe, while the unseen interdiction attacks had no such effects. In addition, close air support was an excellent means of rapidly massing combat power at the decisive point. The more that air leaders opposed the decentralized use of their aircraft for close air support, the more ground commanders felt the need to control some air assets to ensure their availability when needed.

As commander of the Army Ground Forces, General McNair led a vain effort to change Army Air Force priorities. He argued that, even if close air support missions were the exception rather than the rule, that exception should be stressed in training because it was the most difficult form of ground attack mission. Yet the AAF was unwilling to provide aircraft even for major ground maneuvers, let alone small-unit training. Six months before the Normandy invasion, thirty-three U.S. divisions in England had experienced no joint air-ground training, and twenty-one had not even seen displays of friendly aircraft for purposes of recognition in battle. As noted above, in 1943 the AAF arbitrarily changed the radios in fighter-bombers to a type that was incompatible with ground radios. Air and ground units had little understanding of the tactics and capabilities of their counterparts.³⁹

The results were predictably poor. During the North African invasion, ground forces received little air support, and ground commanders with no experience in the employment of tactical air support misused the little that was available. U.S. ground troops saw so few friendly aircraft that they fired on anything that flew. One American observation squadron lost ten aircraft in North Africa--two to enemy air attack, three to enemy ground fire, and five to American ground fire. Gradually, both sides learned to recognize and cooperate with each other, but the process was painful.⁴⁰

The United States did not develop a formal doctrine and training procedure for air-ground cooperation until late in the war. In the interim, effective air support depended upon personalities and initiative in the field. The XII Air Support Command collocated its headquarters with the fifth U.S. Army in Italy, meeting each evening to plan strikes for the next day and improvising a common network of liaison officers and radios. Within the air resources allocated by higher headquarters, the ground operations officer established priorities that the air operations officer rejected only when the proposed use was a technical impossibility. A similar relationship gradually developed between the 9th U.S. Tactical Air Force and some of the U.S. field armies in France and Germany. Yet, even in 1946, AAF officers assigned to study the lessons learned from tactical air operations in Europe continued to describe close air support as a "priority three" mission and recommended the continued use of AAF doctrine on this subject. Meanwhile, in the absence of effective aerial observation support, the ground forces had developed their own aviation, using light aircraft for artillery adjustment, command and control, and movement of critical supplies.⁴¹

Not even the German armed forces were immune to this type of interservice misunderstanding and rivalry. As late as November 1941, for example, the Luftwaffe refused Erwin Rommel's request for a single air liaison officer to arrange on-call aircraft for the Afrika Korps, because such an arrangement "would be against the best use of the air force as a whole." With such attitudes, it is not surprising that German Stukas dive-bombed their own armored divisions on at least one occasion.⁴² On the Eastern Front, of course, German air-ground cooperation reached its peak during the period 1941-43. Thereafter, the growing strength of the Red Air Force and the demands of air defense for Germany against American and British strategic bombardment caused a steady decline in the number and quality of German tactical aircraft. In addition, from 1942 onward the improved quality of Soviet tanks caused the Luftwaffe to experiment with better air-ground antitank weapons, including 30-mm automatic cannon and shaped-charge armor-piercing bombs.⁴³ Thus, although the Luftwaffe developed adequate procedures for air-ground cooperation in most respects, the lack of sufficient aircraft to conduct such support and the technological decline of the Luftwaffe in comparison to its opponents made this support rare after 1943.

The Royal Air Force continued its policy of independence from the British Army well into World War II. As in the U.S., RAF leaders considered strategic bombing and air superiority much more important than air-ground cooperation. From 1942 onward, however, a working compromise developed in three different

theaters almost simultaneously. First, the battles of North Africa demonstrated the importance of air-ground cooperation there. Bernard Montgomery developed an entire network of liaison officers and collocated ground and air headquarters to provide such support while still leaving much independence to the RAF. Second, the British and Commonwealth forces that reconquered Burma eventually developed an even closer relationship with their airmen, a relationship based on their mutual sense of having to depend on themselves because of poor support from Britain. Meanwhile, in Great Britain, RAF Fighter Command sought a more active mission once it had won the Battle of Britain. This institutional need for a new mission coincided with the rise in Fighter Command of one of the few British fliers with extensive experience in close air support--Air Vice-Marshal Sir Trafford Leigh-Mallory. The irritating but effective Leigh-Mallory built the British 2d Tactical Air Force as an instrument to support the Normandy invasion; he then directed both this force and the American 9th Air Force during the 1944 campaign. Even then, the proportion of ground-attack sorties expended on close air support was often much lower than that on interdiction missions that searched for targets almost at random.⁴⁴

By 1945, most armed forces had developed unofficial techniques for effective air-ground cooperation in the field. Such techniques did not resolve the basic doctrinal differences between air and ground components. These disputes persisted in peacetime long after the procedures for close air support were forgotten.

Air Transportation and Air-Landing Forces

One of the neglected aspects of air-ground operations during World War II was the use of air transportation to move supplies and even nonparachute troops within a theater of operations. Just as railroads and trucks had changed the logistical and operational mobility of earlier armies, so air transportation promised to eliminate the historical vulnerability of all ground forces--their land-based lines of communication. Leaving aside for the moment the use of true airborne troops, the techniques of air transportation and supply bear closer examination.

The most significant use of these techniques was in Asia, where vast distances, poor road networks, and few railroads made aerial supply almost a necessity. In order to understand the British use of air transport in Burma, however, we must digress briefly to consider the tactics of Britain's opponent, Japan.

As previously noted, Japanese industry could not hope to compete with the mass production of weapons by its enemies. Much as the Japanese Army would have liked to have had such weapons,

it often had to rely on unorthodox tactics to make up for lack of equipment and firepower. In particular, surprise attacks by night or from unexpected directions seemed to allow the Japanese to close rapidly with the enemy. In hand-to-hand fighting, Japanese leaders believed that their superior morale and training would compensate for shortages of equipment and manpower.⁴⁵

During the conquest of Malaya and Burma in 1942, the Japanese tactics made a virtue out of the lack of heavy weapons. Generally speaking, British and Commonwealth defenders were tied to the few available roads for supply purposes and considered the surrounding hills and jungles almost impassible. Upon contacting the enemy, the Japanese therefore used a small demonstration attack along the road to fix the attention of the enemy and sent a lightly armed infantry force in a long flank march through difficult terrain into the enemy rear. Once in position, the outflanking Japanese force would attack British logistical installations and set up roadblocks behind the bypassed British defenders. The British response was predictable--they turned their combat forces around to fight through the roadblocks behind them and rejoin their logistical support, allowing the Japanese to defeat them in detail. As the war continued and Japanese supplies became even thinner, many Japanese commanders acquired a habit of planning to live off captured enemy supplies. Having achieved their objectives, the Japanese would then establish elaborate bunker defenses that were difficult to identify, let alone destroy, when the British counterattacked.

Some of the British responses to these tactics were simple and effective. Divisions reduced their establishment of wheeled vehicles and trained to secure their flanks and move through "impassable" terrain. To destroy Japanese bunkers, the British 14th Army developed two tactics, which incidentally represented partial solutions to the continuing problems of how to keep the defender pinned down by fire while the attacker covered the final few meters in the assault. First, British tanks accompanying the attack fired a careful sequence of ammunition at the bunkers--simple explosive to clear the jungle, then high explosive with delayed action fuzes to break into the bunkers, and finally solid armor-piercing shot as the infantry made the final assault. So long as the infantrymen stayed out of the tank's direct line-of-fire, they could safely close with the Japanese because this solid shot had no explosive effect. Later in the war, the extremely high degree of cooperation and mutual confidence between air and ground elements in Burma allowed the British close air support aircraft to fly a final, "dummy" bombing pass against the enemy, causing the Japanese to stay under cover until the Allied infantry and tanks were on top of them.⁴⁶

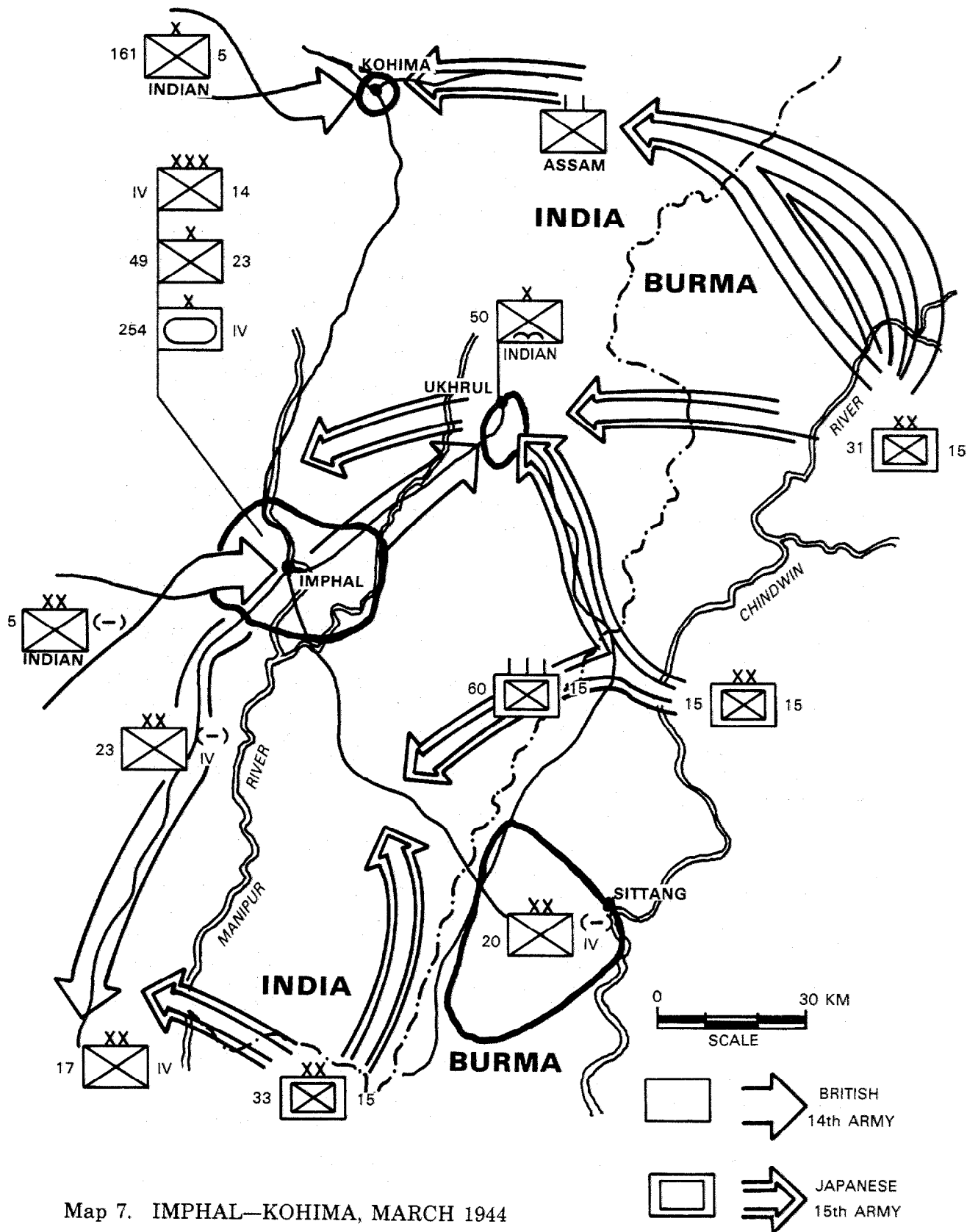
The key to defeating Japanese infiltration tactics was air transportation. In March 1944, Gen. William Slim, the 14th Army commander, correctly predicted a major Japanese offensive against his logistical base area around the town of Imphal (see Map 7). Using large numbers of RAF and U.S. transport aircraft, Slim was able to parachute or air-land supplies to all his bypassed elements, thus allowing them to fight without being tied to their threatened lines of communication. Furthermore, Slim air-landed most of the 5th Indian Division on the airfields around Imphal, and these fresh troops went straight into battle against the infiltrating Japanese.

By 1945, the victorious advance of the 14th Army in the more open country of central Burma was made possible only by a combination of air and surface transportation. Two of Slim's divisions reorganized into an unusual configuration for this advance. Two out of three infantry brigades in each division reequipped with their wheeled transportation, so that they could accompany attached army tank brigades in a mechanized advance down major arteries. As each objective fell, one of these two brigades paused long enough to construct an air strip for resupply. The third brigade in each division was specially equipped with very light trucks and narrow artillery gun carriages that would fit onto transport airplanes. Thus the entire brigade could be air-landed onto airstrips or captured airfields to reinforce the ground elements when they encountered significant resistance. Until that time, the brigade was in essence a divisional reserve that did not burden the logistical system in the combat zone. This combination of armor, wheeled infantry, and air-landed infantry established a tempo of advance that the poorly equipped and foot-mobile Japanese could not hope to match. The only drawback to this form of aerial resupply and redeployment was the need for air superiority or at least air parity to allow hundreds of transport flights into forward areas each day.⁴⁷

Other nations also used air transport for resupply and limited movement of troops. In the German case, air transport--like close air support--was a promising concept that the Luftwaffe was too weak to sustain in many cases. Thus, the surrounded German forces in encirclements like Stalingrad rarely received adequate air resupply.

Airborne Operations

All the considerations and difficulties of close air support and of air transportation loomed even larger when ground troops used parachutes and gliders to land behind enemy lines. In fact, the Americans and British finally decided that the only solution



Map 7. IMPHAL—KOHIMA, MARCH 1944

to such coordination problems was to establish a joint and combined organization--the 1st Allied Airborne Army, which controlled both the troops and the troop carrier aircraft. Even with close integration of air and ground assets, the potential for error in planning and executing airborne operations was great.

In theory, airborne operations appeared as an answer to the difficulties of penetrating prepared defenses--the attacker simply flew over those defenses and assaulted the enemy rear areas. Sudden assault from above had the same psychological effects as early armored penetrations, confusing and disorganizing the structure of the defending army. In practice, of course, planning and communications between the air and ground elements of such an operation were complicated in the extreme. The effects of German air defense, the inaccuracies of air navigation, and the difficulty of controlling early parachutes and gliders during landings meant that most airborne drops were widely scattered. Paratroops had to land prepared to fight as individuals or in ad hoc small groups and without the advantages of organization that make any military unit so much more effective than the sum of its individual members.

In a few operations, such as the German capture of the island of Crete in 1941, airborne troops took and held an objective almost unsupported, but only at great cost in men and equipment. Generally, airborne operations were best conducted in conjunction with a conventional ground offensive, so that the paratroops could link up with the attacking ground forces within a few hours or days of the initial airdrop. Finding such an ideal situation was difficult. Commanders had to abort many planned airborne operations because, by the time the decision was made and planning completed, the advancing ground troops had overrun the proposed drop zones.

Because of the difficulties of transporting heavy weapons and vehicles even in gliders, airborne units could not be equipped like conventional infantry forces. Furthermore, the parachuting personnel often found themselves separated from the gliders and cargo parachutes carrying their heavy weapons. Thus, an airborne unit lacked much of the firepower, protection, and ground mobility of ordinary infantry divisions. Once on the ground, an airborne division was extremely vulnerable to enemy mechanized attack and had to seize and hold its objectives before the enemy could react. Gen. James Gavin and other U.S. airborne commanders concluded that it was better to accept heavy casualties and parachute injuries by landing on or close to the objective than to descend on a safer drop zone that was several miles from the objective.⁴⁸

The poor firepower and mobility of an airborne division was especially significant for the British and Americans, because the shortage of combat troops of all kinds meant that airborne divisions frequently remained in ground combat alongside conventional divisions even after the two forces had linked up. Ultimately, U.S. airborne commanders urged that their divisions be organized and equipped like conventional infantry divisions, with the heavy weapons and vehicles rejoining the airborne division overland after the drop zone had been secured.⁴⁹

Many of the same problems plagued the Soviet efforts in airborne warfare. Despite an initial lead in airborne concepts and training during the 1930s, by 1941 the Red Army's higher level paratroop commanders suffered from the same problems of their more conventional peers--poor leadership and staffwork, inadequate intelligence, and lack of key equipment, including transport aircraft. Of the two division-sized Soviet airborne operations of World War II, the Vyazma landing in early 1942 was at best a partial success, because attacking ground elements never established firm contact between the airborne pockets and the main Soviet lines. The Dnepr landing of September 1943, on the other hand, was a disaster because the troops landed on an unsuspected concentration of German troops. As a result of these experiences, Joseph Stalin virtually ignored airborne tactics and development after the war.⁵⁰

Amphibious Operations

If airborne operations required meticulous cooperation and coordination between two services, air and ground, amphibious operations were far more complex. The opposed amphibious landings of World War II foreshadowed the nature of future wars, when sea, air, and land forces would have to be integrated and coordinated with each other and often with the forces of other nations.

Tactically, the U.S. Marine Corps had developed the doctrine of amphibious landing during the interwar period, at a time when most armies considered such operations impossible. When war broke out, the marines were still struggling to resolve the problems of fire support. An amphibious assault against prepared enemy defenses has all the problems of a deliberate attack, plus the inability of the attacker to bring his own artillery onto the beach immediately and the difficulties of wind and tide as the attacker comes ashore. The solution to these problems, besides careful organization and command and control, was fire support from naval and air units. Yet as late as 1940, the USMC's own aviators followed the familiar argument that air strikes should be used only when conventional artillery was unavailable. Even

during the invasion of Saipan in June 1944, there was only one frequency available for forty-one air liaison teams to control marine close air support, causing considerable delays in air strikes. Still, by the end of the war the USMC had extremely effective and responsive air support, and even naval gunfire was so refined that it could provide a rolling barrage in front of the marine attackers on the beach. Only the flat trajectory of naval guns limited their ability to provide fire support inland.⁵¹

In addition to coordinating the elements of fire support, there was the question of moving the assault infantry and support forces across the beaches and through enemy shoreline defenses. The amphibious tractor gave the attacker that ability even where the water was too shallow for ordinary landing craft. The British Army developed an entire armored division, the 79th, which was equipped with specialized weapons such as amphibious Sherman tanks and mine-roller or flail tanks. This equipment proved invaluable, not only during the invasion of Normandy in June 1944, but also in the assault river crossing of the Rhine in 1945. Both of these operations, with the combination of ground, air, amphibious, and parachute forces of several nations, were models of the steps required to combine many different weapons and units into an effective whole.

Unconventional Warfare

One final specialized weapon was prominent in World War II--unconventional warfare or guerrilla forces. Dozens of German divisions were involved in rear-area protection against partisan forces in the Soviet Union and the Balkans. In France and again in the American reconquest of the Philippines, these guerrilla armies were much more than an additional irritant to the occupying army. On a number of occasions, U.S. and British forces used the guerrillas as an economy-of-force tool, bypassing enemy positions and leaving the guerrillas to protect friendly flanks and rear. This, plus the great intelligence and sabotage potential of guerrillas, made them a significant weapon.

The principal drawback to the Allied use of guerrillas was largely one of perception. Because most military planners regarded the guerrillas as an auxiliary force, dependent upon the conventional armies for weapons and training, they tended to underestimate the capability of guerrillas for independent actions of the type that dominated the 1950s and 1960s.

To some extent, the experience of the German Army reflects the experience of all armies in World War II. Initially, Germany had advantages in training and experience, advantages that

allowed its soldiers to integrate the different weapons on the battlefield and to move so rapidly that their opponents became disoriented and incapable of rapid response. As the war lengthened, the Germans tended to rely increasingly on their air support and high-quality armored formations to perform missions that were inappropriate for such formations, such as penetration of a prepared defense. Heavy tanks took precedence over half-tracks for the accompanying infantry, and thus German production was never able to support a fully mechanized force. Simultaneously, Germany's opponents were learning how better to integrate their forces at a tactical level and how to organize an effective antitank defense-in-depth. Moreover, from 1943 onward improvements in both the quantity and quality of Allied air and ground forces dissipated the early German advantages of training and weaponry. The twin issues of quality and quantity became even more acute for the Japanese, who were never able to compete in manpower and production with their enemies, especially because hundreds of thousands of Japanese troops were tied down in China.

Sheer mass was not sufficient to defeat the Axis forces on the battlefield, however. The Soviet, British, and American armed forces also gained greater skill in combined arms and adjusted their organizations to improve this combination. By 1945, these armies had developed true combat effectiveness at the small unit level, even though that effectiveness was sometimes a product of field improvisation rather than of careful institutional development. At that point, the problem of combined arms integration shifted, at least temporarily, to a higher level of organization. The lingering problems of combining the arms in 1945 were not so much at battalion or division levels as they were between the army and the other services. Air support in particular was a critical link in the success of most offensives in World War II, yet the U.S. Army had only achieved a temporary truce on this issue with the Army Air Forces. Once the war was over, the practical lessons of small unit integration and of air-ground cooperation were frequently forgotten.